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Assembly Manual

Tweed 5E3+

Instructions for Assembling with the:

- Printed Circuit Board (PCB)

with additional modification suggestions and recommended amp settings

version 20
15 May 2014

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Special thanks to:
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Matt Kirby
Henry Lum
Brian Overstreet
Doug Sims
Ben Siler

Special Thanks to Steve Zeller, Todd Fox, Skip Black, Jake Swiatek and Henk Haitjema for their invaluable proofreading skills.

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Preface

Short History of the Tweed Fender ™ Deluxe

The tweed deluxe amplifier has become the “go to” amp when looking for maximum portability and raw, uncompromising tone. With two 6V6 tubes and a single 12” speaker, the tone of this amp is nothing short of amazing. Used by a “who's who” list of musicians, this amp's tone can be found on records, in studios, and on stage around the globe.

With enough power to comfortably sing above the average electrified band, the original Fender™ Deluxe was first introduced in the early 50's as one of Fender's™ new line of tweed amps. It had two 6SL7 metal preamp tubes, two 6V6 power tubes, and a 5Y3 rectifier tube.

With the introduction of the new 12AY7 and 12AX7 preamplifier tubes (replacing the two 6SL7 metal tubes), by 1957 the power output was brought to 15W into a 12” Jensen™ AlNiCo speaker. With these improvements, the iconic amp and tone was born.

It is this incarnation that we provide for you here.

The tweed deluxe is one of my favorite amps. Inside its diminutive size rests the heart of an entire world of music. From blues, to rock-a-billy; from rock-n-roll to soul; from country to jazz, this amp is capable of holding its own across a wide swath of musical history and genres. When it comes to walking into a gig with only a guitar in one hand and an amp in the other, there is no other amp that can provide this depth of expression in such a simple package.

Therefore imagine my excitement in designing a kit where you can build an incredible amp on which to put your musical mark on the world. Wow … this is going to be fun!

Thank you for purchasing this great TubeDepot Tweed 5e3+ kit. You should be able to easily put this kit together in an evening or two … whether you have any prior amp building experience or not. I designed this kit for you to enjoy both building and playing. And once finished, this kit will allow you to make the best music you can and to leave your mark on the world.

Now, let's have some building and playing fun.

Robert Hull
Director of Technical Services
TubeDepot.com

“Deluxe” and “Fender” are the property of Fender Musical Instruments Corporation (FMIC). TubeDepot is not affiliated or associated with FMIC or its subsidiaries and FMIC does not sponsor or endorse any of TubeDepot’s products.

1 Safety

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!!! Read these safety precautions before continuing !!!

ALL tube amplifiers contain **LETHAL VOLTAGES,** often several hundred volts which **WILL** leave burnt entrance and exit wounds in skin. These voltages have the potential to cause **permanent physical damage and death**. These voltages are present when the amp is turned on and also for some time after the amp has been turned off. **You can still get shocked with a tube amp turned off and disconnected from AC power.**

The above statement is a bit scary, but we want to stress that every piece of electronic equipment must be treated with respect. When AC power is applied, there is always a chance for injury or death. With tube amps, even when the AC power is not applied there is still danger. Being shocked with high voltage is very painful and we do not want anyone finding out the hard way.

When building this kit, we want your experiences to be both enjoyable and safe. There are more kits to assemble and we want you to enjoy building and playing them all.

- DISCLAIMER -

TubeDepot.com, it's employees, officers, shareholders, investors and subsidiaries accept no liability for any damage(s), injury(s) or death incurred from or while building or using this kit.

TubeDepot.com reserves the right to make changes to this manual as new construction methods are found to be more efficient and/or safer. When a particular procedure in this assembly manual differs from the assembly video, our recommendation is to follow this manual to insure the best construction possible.

Throughout this manual at key points in the construction, we have annotated important steps with the below alerts. For your safety and to improve construction quality, It is important that you become familiar with each of these alerts and adhere to their recommendations when they appear.

Explanation of Alerts

WARNING - *Used when identifying an action that may cause physical injury or death.*

CAUTION - *Used when identifying an action that may cause damage to components and/or equipment.*

NOTE - *Used when identifying general points of interest.*

2 Tools and Supplies

As with any construction project, there are certain tools and supplies that are recommended to complete the project. These are tools and supplies not provided with the kit and are instead provided by the builder.

The following is our recommended list:	***TubeDepot.com part number***
Phillips screwdriver, #1 and #2	TL-VTSCRSET8
Slip joint pliers	
Needle nose pliers	TL-VT33
Wire cutters, diagonal	TL-VT33
Wire strippers, for 18 and 20 awg wire	TL-VT5021
Electric Drill (cordless recommended)	
Drill bit, 3/16” - Chassis mounting into the cabinet	
Drill bit, 5/32” - PCB and turret board chassis mounting	
Masking tape, 2”	
Ruler or scale, 12” w/ 1/16” markings	
Permanent marker, fine tip	
Soldering iron, 25W – 40W (35W recommended)	TL-WP35
Solder, electronics safe (60/40 w/ rosin core recommended)	TS-24-6040-0027
Flux, electronic – liquid or paste (must be safe for electronic work)	TS-83-1000-0186
De-soldering pump extractor	TS-384-1000
Solder wick	TS-1817-10F
Sponge	

The following are really nice to have:

Soldering station w/ temperature control	TL-WTCPT
Multimeter w/ DC range of at least 500V	TL-DVM850BL
Variable AC supply (Variac® style)	
Current Limiting AC source (dim bulb tester) – self built	
Needle nose pliers – small size, for electronics work	TL-NN7776
Wire cutters, diagonal – small size, for electronics work	TL-170M
Center punch	
Nutdrivers - 5/16”, 11/32”, 7/16”, 1/2”	
Square, 9”	
Scratch Awl	
De-burring tool	TL-DB-1
Fingernail polish (for holding nuts and screws in place)	

3 Parts Inventory

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It is important to review all the parts that came with your kit. The list below is what you should have received to complete your kit. If you find anything missing, contact us:

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(877) 289-7994
info@tubedepot.com

Qty	Description	
	Speaker, Chassis, Cabinet, PC Board	
1	speaker, 12" Jensen MOD, 8ohms	
1	chassis, steel chrome plated 5E3	
1	cabinet, tweed 5E3	
1	PCB board, 5E3	
	Transformers	
1	transformer, high performance power BF 20W w/ export taps	
1	transformer, high performance output BF 20W, 8 ohm	
	Tubes	
1	5AR4 / GZ34 rectifier tube	various brands
2	6V6GT beam power tetrode	various brands
2	12AX7 / ECC83 dual triode	various brands
	Hardware, Cabinet (provided with cabinet)	
4	bolt 1 1/2” 6x32 copper plated truss screw	baffle mounting bolts
4	bolt 1 1/2” 8x32 flat head, black oxide coated	speaker mounting bolts
4	nuts, KEPS 6x32	baffle mounting nuts
4	nuts, KEPS 8x32	speaker mounting nuts
1	handle, brown flat leather w/ mounts and screws	handle assembly
4	feet, metal glide w/ screw	glide feet
8	screw, #6 oval head phillips, 1 1/4” stainless steel	back panel screws
	Hardware, General	
3	knob, vintage pointer	volume and tone knob
1	fuse holder, conical cap, vintage style	fuse holder
2	fuse, 3AG 2A slow-blow	fuse (one extra fuse)
1	lamp holder	indicator lamp holder
1	jewel, red	red jewel
1	lamp, #47, 6.3 V	lamp
4	jack, 12A, shorting, Switchcraft ¼"	input jacks
2	jack, 11A, open, Switchcraft ¼"	speaker output jacks
9	washer, lock; 3/8"	lock washer for jacks and potentiometers
1	plug, Switchcraft ¼"	speaker phone plug
2	switch, toggle SPST; Carling	power and standby switches
2	washer, lock 1/2”	lock washer for switches
1	power cord, grounded three prong, 12'	power cord
1	strain relief, Heyco	strain relief
1	nylon cable clamp	cable clamp
1	screw, zinc plated #8 x 5/8", phillips flat head	cable clamp screw
2	screw, zinc plated 6-32 x 3/8", phillips pan head	V1 tube socket shock mounting
2	washer, flat zinc plated, #6 screw	V1 tube socket shock mounting
2	grommet, rubber 1/4" chassis hole / #6 screw	V1 tube socket shock mounting
2	grommets, rubber 3/8" hole	rubber chassis grommets
4	washer, neoprene bonded	speaker mounting
2	bolt, 1 1/2" 10x32 truss screw	chassis mounting
2	nuts, KEPS 10x32	chassis mounting
10	screw, zinc plated 6-32 x 1/4", phillips pan head	tube socket mounting
13	nuts, KEPS 6x32	tube socket / PC board mounting
2	nuts, 6x32	preamp tube socket mounting
4	screw, zinc plated 6-32 x 1/2" phillips pan head	PC board mounting
4	standoff, nylon; L = .25"; id = .140"; od = .250"	PC board mounting
4	nuts, KEPS 8x32	power / output xfmr mounting
2	nuts, 8x32	power xfmr mounting

2	screw, zinc plated 8-32 x 1/4", phillips pan head	output xfmr mounting
1	screw, zinc plated #6 philips pan head	back panel ground connection
2	solder lug, locking, #8 screw	power xfmr mounting / chassis ground
2	solder lug, locking, #6 screw	preamp tube socket mounting / chassis ground
1	header, 3 pin / two position	feedback select
1	shorting jumper	feedback select
3 ft.	alum. tape, 2" width, self adhesive	electrical and temperature shieldin
2	heat shrink, 1/8" - black, 6" piece	insulation, wire dressing
2	wire nut, 20AWG – 14AWG	AC wiring
2	rubber foot, clear adhesive	PC board anti-vibration
	Tube Sockets	
2	socket, tube, miniature 9 pin	preamp tube sockets
3	socket, tube, octal, 8 pin	power and rectifier tube sockets
	Resistors	
2	100, 1/2w carbon film	pseudo filament center tap
1	820, 1/2w carbon film	cathode resistor
4	68K, 1/2w carbon film	input resistor
3	1M, 1/2w carbon film	preamp tube grid biasing
3	100K, 1/2w carbon film	plate resistor
4	1.5K, 1/2w carbon film	cathode resistor
2	56K, 1/2w carbon film	bias resistor
2	220K, 1/2w carbon film	power tube grid biasing
1	2.7K, 1/2w carbon film	feedback resistor
1	47, 1/2w carbon film	feedback resistor
1	250, 5w metal oxide	power tube cathode resistor
1	4.7K, 3w metal oxide	B+ voltage divider resistors
1	22K, 1w metal oxide	B+ voltage divider resistors
2	470, 2w metal oxide	screen grid resistors
	Capacitors	
1	500pfd / 500V	tone capacitors
1	.0047ufd / 630V	tone capacitors
1	.022ufd / 630V	coupling capacitors
4	.1ufd / 630V	coupling capacitors
1	.01ufd / 630V	coupling capacitor (alternate for C7 cap)
3	22ufd / 50V	cathode bypass capacitors
3	22ufd / 500V	power supply filter capacitors
	Potentiometers	
3	1M audio	volume and tone controls
	Wire	
10 ft	wire, 20 awg, stranded, hi-temp PVC – yellow	general signal wiring
8 ft.	wire, 20 awg, stranded, hi-temp PVC – red	B+ and input signal wiring
8 ft.	wire, 20 awg, stranded, hi-temp PVC – black	ground
4 ft.	wire, 18 awg, stranded, hi-temp PVC – green	filament wiring
2 ft.	wire, 18 awg, stranded, hi-temp PVC – black	speaker
2 ft.	wire, 18 awg, stranded, hi-temp PVC – white	speaker
1 ft.	wire, 20 awg, solid buss wire, tinned copper	ground wire across volume and tone controls

---

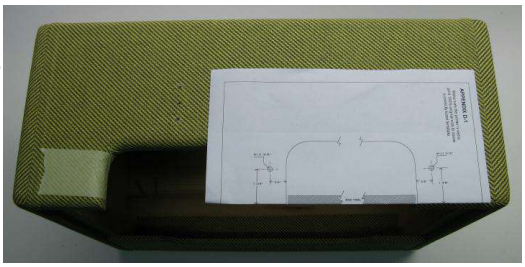
4 Cabinet Preparation

This chapter deals with preparing the cabinet for installation of the completed chassis. But first, we need to take inventory of the parts that came installed on the cabinet.

1. **Handle w/ mounting hardware** – There should be a single flat brown leather handle with two metal securing ends all fastened to the cabinet with four screws.
2. **Feet, chrome metal glide** – There should be four metal feet attached with screws to the underside of the cabinet.
3. **Back panels, upper and lower with screws** – There should be two back panels. The top back panel should be secured with four panel screws, the bottom panel should be secured with four panel screws.
4. **Baffle bolts with nuts** – There should be four bronze plated bolts attaching the baffle to the cabinet. The baffle is secured with four KEPS nuts, one on each of these bolts.
5. **Speaker bolts with nuts** – There should be four black oxide coated bolts for securing the speaker to the baffle board. Additionally, there should be four KEPS nuts, one on each of these bolts to be used when mounting the speaker.

photo 4.1a

4.1 Drilling for the Chassis Mounting Bolts



Step 1 – Remove the amp handle from the top of cabinet and remove the top back panel.
Step 2 – Apply masking tape on each side of cabinet opening (photo 4.1a).
Step 3 – Remove template page from manual (appendix D1) and fold on indicated line.

CAUTION *Some printers may automatically reduce the size of the template when printed. Therefore, prior to use, always physically measure the printed template to insure proper scale is maintained.*

CAUTION *Be certain of template placement before drilling. The rounded edges of the cabinet can skew measurements and cause improper placement. Always measure several times before drilling.*

Step 4 – Place template on top of cabinet. Properly align over the right opening (photo 4.1b).
Step 5 – With a pointed tool, make a mark through the template at the cross hair points marked “drill 3/16” (photo 4.1c). Press lightly into the tape and cabinet. This mark should be just deep enough to see the mark on the masking tape underneath.
Step 6 – Repeat step 4 & 5 for the left edge
Step 7 – Remove the template. With a ruler or scale, check and verify that the marks are properly aligned on the cabinet top as referenced to the measurements on the template.

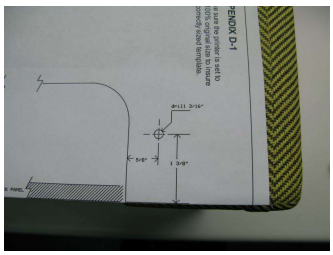


photo 4.1c

Step 8 – If the marks are verified correct, drill the two 3/16” holes, one at each of these two marks all the way through the top of the tweed cabinet.
Step 9 – Remove the masking tape and clean up any loose splinters and / or tweed from the

holes and install the chassis mounting bolts.
Step 10 – Test fit the chassis onto the bolts to make sure the holes are properly aligned.
Step 11 – Remove chassis and reinstall handle, leaving chassis mounting bolts installed.
Proceed to 4.2

4.2 Installing the Speaker

Step 1 – Remove the four nuts from the speaker mounting bolts inside the cabinet.
Step 2 – Remove the speaker from its shipping box. With speaker in hand, carefully align the speaker mounting holes to the baffle bolts. I recommend installing the speaker with connecting terminals on top.
Step 3 – Slowly press the speaker onto these bolts, being certain that the bolts are proceeding through the mounting holes of the speaker equally (photos 4.2a).

CAUTION *Alignment of all holes during speaker installation is crucial Otherwise, one or more of the bolts may accidentally puncture the speaker cone.*

photo 4.2a

photo 4.2b

photo 4.2c

Step 4 – Once the speaker is installed on the bolts, install the neoprene bonded washers (photo 4.2b) and press the bonded washer **fully against the speaker frame.**
Step 5 – Once the neoprene bonded washers are mounted on the bolts, install and tighten the KEPS nuts.

CAUTION *It is important to fully tighten the KEPS nuts so that the lock washer around the nut does not spin. If loose, this lock washer will cause a vibrational "buzz" when the amp is played.*

Step 6 – With the nuts and washers tight, I recommend using a small dab of fingernail polish to further guarantee that the nuts do not come loose or the lock washer buzzes (photo 4.2c).
Proceed to steps 4.3

4.3 Wiring the Speaker

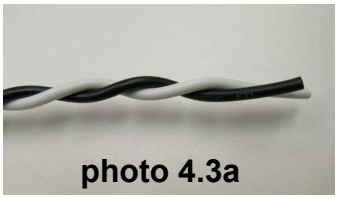


photo 4.3a

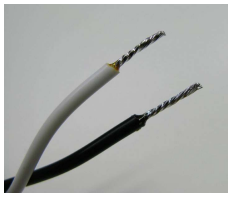


photo 4.3b

Step 1 – Twist the two 15" lengths of black and white wire together (photo 4.3a).
Step 2 – At one end, strip the insulation back ½ " from both wires and tin these two wires (photo 4.3b).
Step 3 – Unscrew the barrel of the ¼ " phone plug.
Step 4 – Solder the two tinned wires to the plug; white to center and black to shield (photo 4.3c). Reinstall plug barrel.
Step 5 – At the opposite end of the twisted wire pair, strip back the insulation ¼" and tin these two wires.

NOTE

The ¼" phone plug was invented for use in telephone switchboards in 1878. Although it is no longer used for telephone switching, this great plug has become the standard connection type between musical instruments and outboard equipment.

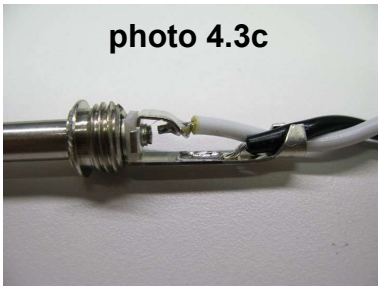


photo 4.3c

Step 6 – Solder these wires to the solder terminals of the speaker; the white wire to the "+" terminal and the black wire to the "-" terminal (photo 4.3d).
Proceed to 4.4

4.4 Installing the Shielding Tape

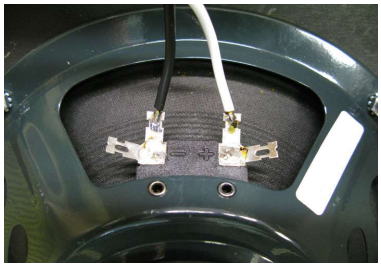


photo 4.3d

Step 1 – Place the removed back panel with the tweed side toward the desk and the wood side facing up.
Step 2 – Cut the aluminum shielding tape strip into two equal lengths of 16"
Step 3 – Remove the backing from the first of the shielding tape strips.

CAUTION

Once the backing is removed from the aluminum tape, the tape will have a tendency to curl. Be sure to keep the tape straight to avoid having the tape stick permanently to itself.

Step 4 – Apply the aluminum tape to the back of the panel. Leave 1/8th of an inch space at the top of the panel and center the strip between the two panel edges (photo 4.4a).
Step 5 – Remove the backing from the second shielding tape strip and apply the tape to the back of the panel similar to the previous strip. Align the edge of the tape along the bottom edge of the panel, offset by 1/8th of an inch from the bottom edge of the panel and overlapping the second strip (photo 4.4b).
Proceed to chapter 5

photo 4.4a

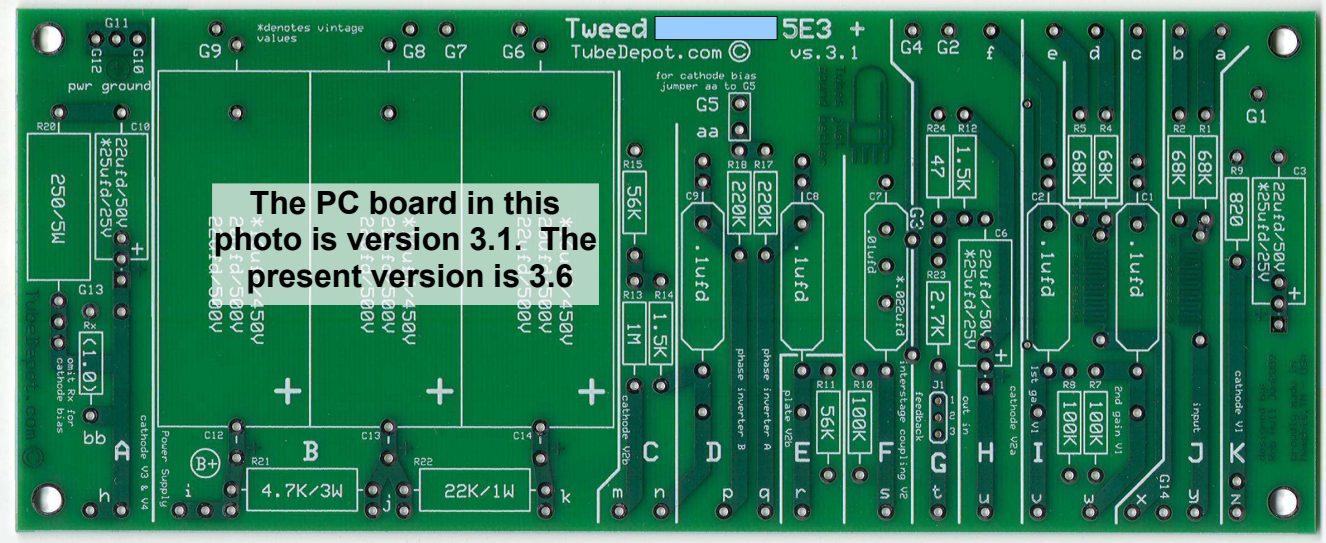
photo 4.4b

5 Circuit Assembly

Here is where good soldering skills and attention to detail will pay off. By following these directions, you should have no trouble in completing the circuit assembly quickly and without errors.

I encourage you to first read all the steps to familiarize yourself with not only the installation flow, but also the components to be used. Appendix A has explanations on how to read the value codes found on both the resistors and capacitors. Appendix B has helpful hints on improving your soldering skills.

Printed Circuit Board (PCB) Assembly



5.1 Installing the Components

This PC board was designed for both great tone and ease of assemble. This PC board layout closely follows the original point-to-point layout in order to duplicate any tone shaping created by component and wiring proximity interactions. Additionally, there are built-in modification options available exclusively with this board. With over-sized traces and through-hole plating, this board will provide years of trouble free life.

Resistors

Step 1 – Gather all components together. Separate the components by type (resistors, capacitors, header, jumper, and wire). Install resistors first. Resistors have no polarity and can be installed in either direction.

NOTE *For hints on improved soldering skills, review Appendix B at the end of this manual. Additionally, visit: http://www.youtube.com/user/TubeDepotTV and watch "How To Solder".*

CAUTION *Once soldered, be sure to clip all component leads close to the circuit board. If the leads are too long, they risk shorting or arching against the chassis when the PCB is installed.*

Step 2 – Install a 820 ohms / ½ watt resistor (gray, red, brown, gold) in R9 position.
Step 3 – Install 68K (68000) ohms / ½ watt resistor (blue, gray, orange, gold) in positions R1, R2, R4, and R5.
Step 4 – Install a 100K (100,000) ohms / ½ watt resistor (brown, black, yellow, gold) in positions R8, R7, and R10.

Step 5 – Install a 2.7K (2,700) ohms / ½ watt resistor (red, violet, red, gold) in position R23.
Step 6 – Install a 47 ohms / ½ watt resistor (yellow, violet, black, gold) in position R24.
Step 7 – Install 1.5K (1,500) ohms / ½ watt resistors (brown, green, red, gold) in positions R12 & R14.
Step 8 – Install 220K (220,000) ohms / ½ watt resistors (red, red, yellow, gold) in positions R17 and R18.
Step 9 – Install a 1M (1,000,000) ohms / ½ watt resistor (brown, black, green, gold) in position R13.
Step 10 – Install a 56K (56,000) ohms / ½ watt resistor (green, blue, orange, gold) in positions R11 and R15.
Step 11 – Install a 22K (22,000) ohms / 1 watt resistor (red, red, orange, gold) in position R22.
Step 12 – Install a 4.7K (4,700) ohms / 3 watt resistor (yellow, violet, red, gold) in position R21.
Step 13 – Install a 250 ohms / 5 watt (or upgrade to the 8W Brown Devil) resistor in position R20 (photo 5.1a).

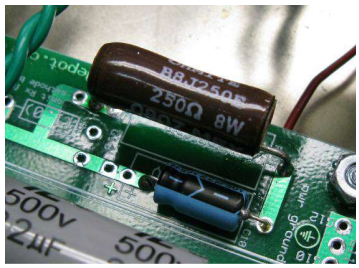


photo 5.1a

NOTE *Many small tube amps from the late 50's into the mid 60's used Ohmite "brown devil" resistors as the cathode resistor of the power tube(s). Although more expensive, this is the preferred resistor to use because of its durability and small size. And it looks great too!*

Capacitors

NOTE *The on-board positions for all coupling and electrolytic capacitors have additional pads for accommodating different lead spacings of different sized components. It is recommended to utilize the pad spacings that closely match the leads of the component you are installing.*

Step 14 – Install a .022ufd coupling capacitor (223) in position C7. It is important to install the capacitor leads in the two holes as shown in photo 5.3b. This capacitor does not have a polarity and can be installed in either direction.

NOTE *Position C7 is critical to overall tone shaping of the amp. If after you have assembled the amp the tone is too muddy sounding, try changing C7 value to .01 or .0047 to reduce the low end response of the amp. I usually install a .01 ufd cap here by default.*

Step 15 – Install a .1 ufd coupling capacitor (104) in positions C1, C2, C8 and C9. These capacitors do not have a polarity and can be installed in either direction.

CAUTION *Electrolytic capacitors DO have a polarity and must be installed according to the markings on the component and the PC board. The arrow on the case points to the negative lead*

NOTE *When installing electrolytic caps, it is good practice to install the component with the value, voltage rating, and polarity markings facing up. This makes reading the component easier.*

NOTE *When installing large electrolytic caps, it is good practice to secure the component to the board with a small bead of silicon adhesive. This will keep the component firm against the board, removing the chance for the component to vibrate when the amp is played.*

Step 16 – Install a 22ufd / 50V electrolytic capacitor in positions C3, C6, and C10. These components have a polarity, therefore they must be installed according to case and board markings. **The arrow points to the negative lead**.
Step 17 – Install a 22ufd / 500V electrolytic filter capacitor in positions C12, C13, and C14. These components have a polarity, therefore they must be installed according to case and board markings (photo 5.3b).**Proceed to 5.2**

5.2 Installing Feedback Header / Jumper J1

Step 1 – Locate position J1 on the board. It is identified by the three small pads next to the printed word "feedback", above the large letter "G".
Step 2 – Install the three pin header in these three holes (photo 5.2a / b).
Step 3 – Install the jumper onto the two pins nearest R23 (the "out" position).
Proceed to 5.3

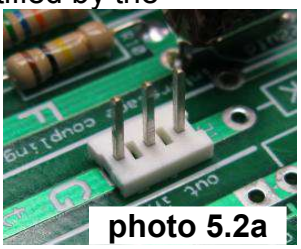


photo 5.2a

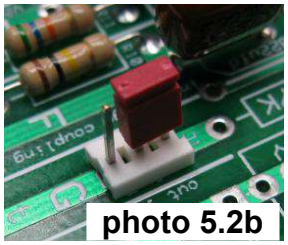


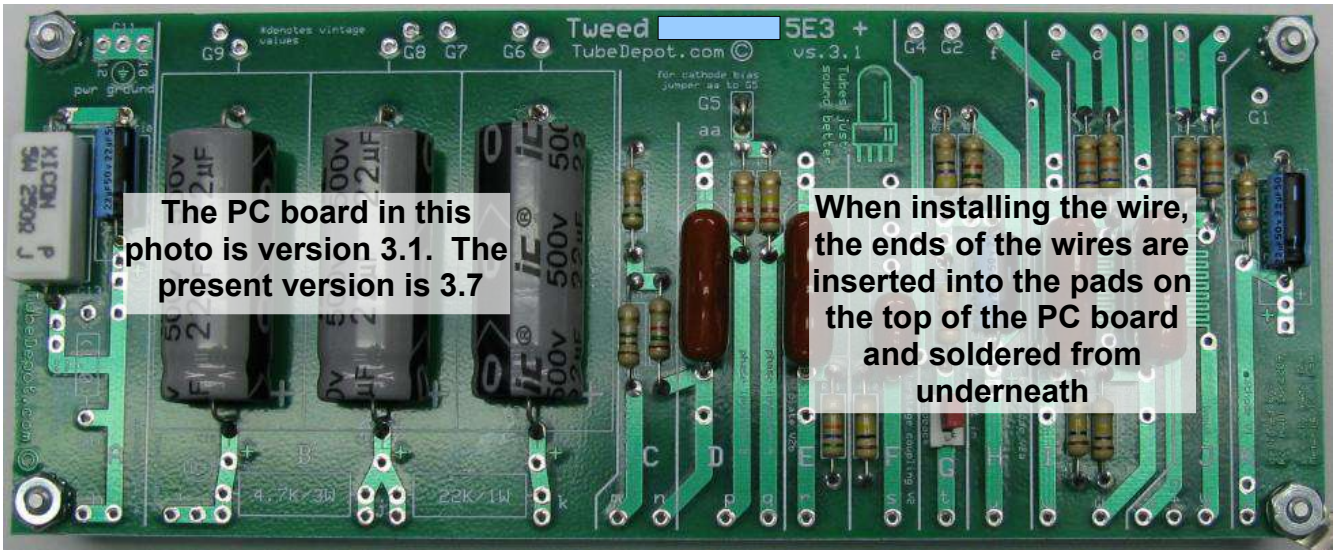
photo 5.2b

NOTE *With the FEEDBACK jumper in the "OUT" position, the amp will have stronger midrange response and be quick to distort. This is the stock setting. With the jumper in the "IN" position, the amp will be cleaner, with a flatter frequency response and better low end punch.*

5.3 Installing the Cathode Bias Jumper

Step 1 – Locate the small box labeled "G5 / aa" printed in the middle of the circuit board.
Step 2 – With a small length of bare wire (a cut component lead will do great), connect (jumper) these two pads (G5 and aa) together and solder (photo 5.3a).
Proceed to 5.4

photo 5.3a


Tweed 5E3
TubeDepot.com ©
vs.3.1
G5
aa
The PC board in this photo is version 3.1. The present version is 3.7
When installing the wire, the ends of the wires are inserted into the pads on the top of the PC board and soldered from underneath
photo 5.3b – filled board

5.4 Installing the Wires to the Board

5.4.1 Black Wires (Grounding)

Step 1 - Strip back the insulation 1/8" from the end of a black 20 AWG wire. Tin the end of the exposed strands. Insert the tinned end of this wire into the pad labeled "G1" on the PC board top (where the components are mounted) and solder into place. Measure and cut this wire to a length of 3" from pad G1.
Step 2 – Repeat the above for pad "G2".
Step 3 – Repeat above for pad "G7" except extend wire to 4".
Step 4 – Repeat above for pad "G10" except use 6" of **18AWG** wire.
Proceed to 5.4.2

5.4.2 Red Wires (Circuit B+ and Preamp Tube Inputs)

Step 1 - Strip back the insulation from the end of the red wire 1/8" and tin the end of the exposed strands. Insert the tinned end of this wire into the pad labeled "a" and solder. Measure and cut this wire to a length of 3" from pad "a".
Step 2 – Repeat above for pads "b", "d", and "e".
Step 3 – Repeat above for pads "x" and "y" except extend the wires to 3.5".
Step 4 – Repeat above for pad "j" except extend the wire to 3.5".
Proceed to 5.4.3

5.4.3 Yellow Wires (General Signal Routing)

Step 1 - Strip back the insulation from the end of the yellow wire 1/8" and tin the end of the exposed strands. Insert the tinned end of this wire into the pad labeled "h" and solder. Measure and cut this wire to a length of 3" from pad "h".
Step 2 – Repeat above for pads "m", "n", "r", "s", "u", "v", "w", and "z" except extend the wire to 3.5" for each.
Step 3 – Repeat above for pad "c" and extend the wire to 5".
Step 4 – Repeat above for pads "f" and "t", except extend the wires to 6".
Step 5 – Repeat above for pad "q" except extend the wire to 7".
Step 6 – Repeat above for pad "p" except extend the wire to 9".
Proceed to 5.5

5.5 Installing the Anti-Vibration Bumpers

NOTE *In order to keep mechanical vibrations to a minimum, I recommend installing the two plastic bumpers on the underside of the PC board prior to installing in the amp.*

Step 1 – Remove one of the clear plastic bumpers from its backing and stick it near the center of the PC board. Avoid attaching it to any component pads.
Step 2 – Remove the remaining bumper from its backing and stick it on top of the first bumper already attached to the PC board (photo 5.5a).
Proceed to Chapter 6

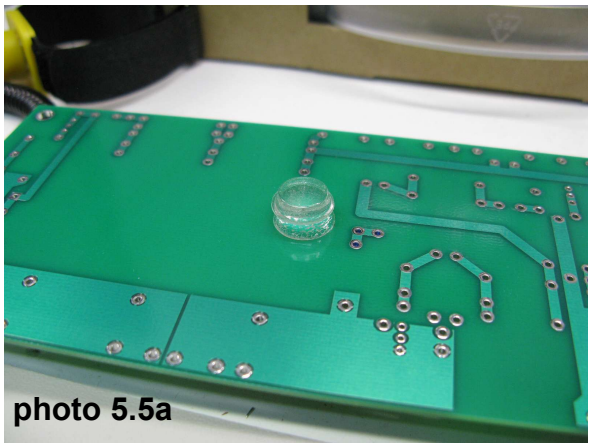


photo 5.5a

6 Chassis Preparation

6.1 Drilling Mounting Holes for the Printed Circuit Board (PCB)

There are two acceptable methods for determining where to drill the holes for mounting the circuit board, the template method (6.1.1) and the positional method (6.1.2). Choose the method that works best for you.

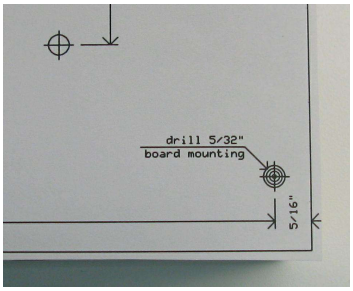


photo 6.1a

photo 6.1b

6.1.1 Template Method

Step 1 – Locate the template "drilling template chassis/5E3" in Appendix D2. Verify that the template drill markings correctly align with the PC board mounting holes.

CAUTION *Some printers may automatically reduce the size of the template when printing. Therefore, prior to use, always physically measure the printed template to insure proper scale is maintained.*

Step 2 – Once verified, situate the chassis with the large chrome side facing up and the printed control panel facing toward you. Place the template onto the chassis. Make sure the template markings line up with the actual chassis edges.
Step 3 – On the template, locate the four concentric circular drill indicators (photo 6.1a).
Step 4 – With a sharp, hardened tool (center punch is great), make a mark at the center of these drilling indicators, leaving an identifiable indentation / mark on the chassis (photo 6.1b).

NOTE *A sharp, large nail and hammer make a great make-shift center punch. By placing the nail on the template mark and firmly tapping the head of the nail with the hammer, the resultant mark in the metal is great for accurately guiding the drill bit into the chassis.*

Step 5 – Utilizing the printed measurements from the template, verify that these marks are correctly situated on the chassis.
Step 6 – Once verified, drill four, 5/32" holes, one hole at each of these marked spots.

NOTE *Use a new drill bit when drilling this chassis. Go slowly through the steel at a low rotational speed. A little drop of light oil at each drilling point helps too. These practices will allow the metal to be cut cleanly with minimal formation of burrs.*

Step 7 – Remove any burrs around holes. A deburring tool is very helpful here. Verify results by lining up mounting holes with PC board.
Proceed to step 6.2

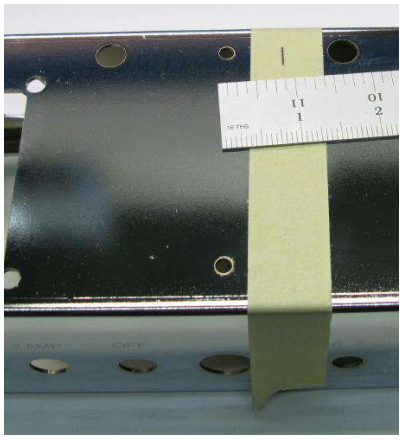


photo 6.1c

6.1.2 Positional Method

Step 1 – Situate the chassis with the large chrome side facing up with the printed control panel facing toward you.
Step 2 - Apply a 1" strip of masking tape across chassis, situated between the hole for the output transformer secondary and the mounting hole for the output transformer (photo 6.1c).
Step 3 – Divide the distance between the edges of these two holes (5/8" is middle) and place a mark on the masking tape

(photo 6.1c).
Step 4 – Place the circuit board on the chassis. Align one of the short edges of the circuit board against the mark on the masking tape and center the two long edges equally between the two chassis sides (photo 6.1d).
Step 5 – With a permanent marker, place a mark on the chassis through each of the four holes at each corner of the circuit board.
Step 6 – Remove the circuit board. With a center punch (or something similar), place a solid mark into the chassis at each of the permanent marker points.

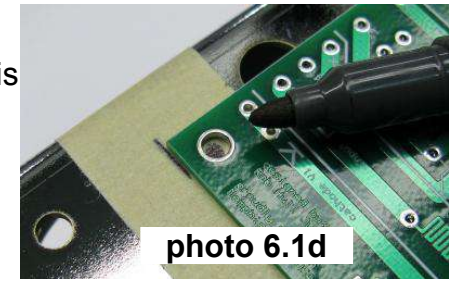


photo 6.1d

NOTE *A sharp, large nail and hammer make a great make-shift center punch. By placing the nail on the permanent marker mark and firmly tapping the head of the nail with the hammer, the resultant mark in the metal is perfect for accurately guiding the drill bit into the chassis.*

Step 7 – Lay the circuit board onto the chassis and verify that the marks line up correctly with the four corner mounting holes of the circuit board.
Step 8 – Once verified, remove the circuit board and drill four, 5/32" holes, one hole at each of these marked spots.

NOTE *Use a new drill bit when drilling this chassis. Go slowly through the steel at a low rotational speed. A little drop of light oil at each drilling point helps too. These practices will allow the metal to be cut cleanly with minimal formation of burrs.*

Step 9 – Remove any burrs around holes. A deburring tool is very helpful here. Verify results by lining up mounting holes with PC board.
Proceed to step 6.2

photo 6.2a

6.2 Mounting the Power Transformer

Step 1 – Loosely twist all power transformer wires together and slowly guide the wire bundle through chassis opening.
Step 2 – Situate the transformer so that the primary wires (black wires) will be nearest the fuse holder and the secondary wires (reds, yellows, greens) will be nearest the rectifier tube socket.
Step 3 – Install and tighten two #8 KEPS nuts on the transformer mounting bolts nearest the edge side of the chassis (photo 6.2a).
Step 4 – Bend the two #8 solder tabs at a slight angle (photo 6.2b).
Step 5 – Install these tabs on the remaining two transformer bolts, oriented at angles toward the chassis edges (photo 6.2a).
Step 6 – Install the two #8 standard nuts on these two bolts with the solder tabs (photo 6.2a).
Proceed to 6.3

Photo 6.2b

6.3 Installing the Rubber Grommets

photo 6.3a

photo 6.3b

Step 1 – locate the two 3/8" rubber grommets and the two corresponding holes on the chassis.
Step 2 – Insert the two rubber grommets in the chassis holes (photos 6.3a and 6.3b).

6.4 Proceed to 6.4

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Mounting the Output Transformer

NOTE *The various output transformers available with this kit have differing wire colors.. Refer to **appendix F** for applicable installation directions and options.*

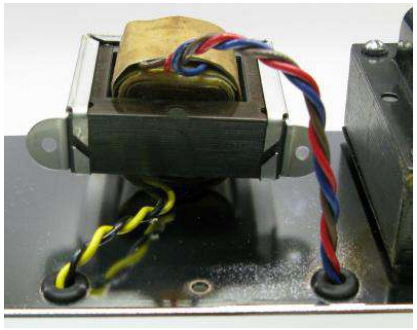


photo 6.4a

Step 1 – Twist the primary wires together (red, brown and blue).
Step 2 – Twist the secondary wires together (either yellow and black; or green and black; or yellow, black and brown wires).
Step 3 – Feed the two wire sets into the grommets (photo 6.4a). The red, blue and brown primary wires go into the grommet nearest the power transformer **(see appendix F for various output transformer wiring options).**
Step 4 – Pull the two wire bundles tightly through the grommets
Step 5 – Secure the output transformer to the chassis with two #8 KEPS nuts and the two #8 x 1/4" screws. The two KEPS nuts should be mounted on the inside of the chassis.
Proceed to 6.5

6.5 Mounting the three 1M potentiometers

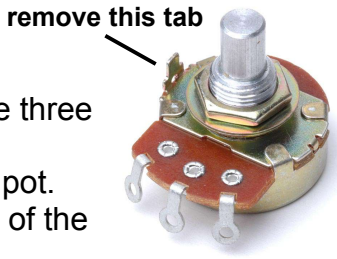


photo 6.5a

photo 6.5c

Step 1 – Locate the three 1M potentiometers and the three 3/8" lock washers.
Step 2 – Remove the nut and flat washer from each pot. Remove the keying tab (by cutting off or bending out of the way) flush from each pot (photo 6.5a)
Step 3 – Install a lock washer on each pot (photo 6.5b).
Step 3 – Insert each pot with appropriate lock washer into corresponding hole in chassis (lock washer should be on the inside of chassis).

photo 6.5b

Step 4 – Rotate each pot where solder terminals are facing toward the outside of the chassis (photo 6.5c)
Step 5 – Tighten all nuts with a 1/2" socket.
Proceed to 6.6

6.6 Mounting the Indicator Lamp

photo 6.6a

Step 1 – Remove the nut from the bezel holder.
Step 2 – With the nut removed, remove the lamp frame.
Step 3 – Place the bezel holder through the corresponding opening in the chassis.
Step 4 – Install the lamp holder on the threaded end of the bezel holder.
Step 5 – Thread the nut onto the threaded end of the bezel holder.
Step 6 – Position the indicator lamp with the lamp frame toward the chassis (photo 6.6a).
Step 7 – Tighten the nut to firmly secure the assembly to the chassis.
Step 8 – Apply a drop of fingernail polish to the threads and nut to lock in place (photo 6.7a).

NOTE *By placing the point of a center punch on one of the corners of the lamp assembly nut and tapping the center punch, the nut can be firmly tightened*

Proceed to 6.7

6.7 Mounting the Fuse Holder

Step 1 – Remove the nut from the fuse holder and insert the fuse holder into the corresponding chassis opening. The rubber gasket should be situated on the outside of the chassis.
Step 2 – Reinstall the threaded nut on the fuse holder and tighten it against the chassis.
Step 3 – Keep the nut from loosening by painting the exposed threads with fingernail polish (photo 6.7a).
Proceed to 6.8

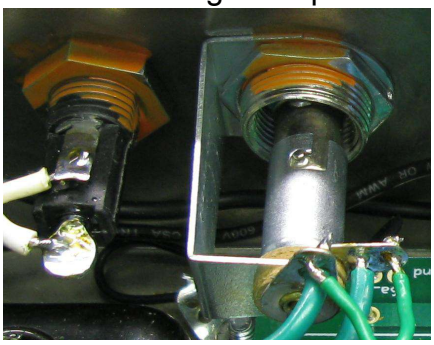


Photo 6.7a

6.8 Mounting the Power Switch

Step 1 – Remove all mounting nuts from the switch.
Step 2 – Reinstall the knurled round nut, threading it to the body of the switch (photo 6.8a).
Step 3 – Install the large 1/2” lock washer on the switch.
Step 4 – Install the switch into the appropriate hole in the chassis with the solder terminals facing up (photo 6.8b).
Step 5 – Thread the hex nuts onto the exposed switch threads and tighten firmly.
Proceed to 6.9

Photo 6.8a

Photo 6.8b

6.9 Mounting Ground / Standby Switch

Step 1 – Remove all mounting nuts from the switch.
Step 2 – Reinstall the knurled round nut, threading it to the body of each switch (photo 6.8a).
Step 3 – Install the large 1/2” lock washer on each switch.
Step 4 – Install the switches into the appropriate holes in the chassis with the solder terminals facing up (photo 6.8b).
Step 5 – Thread the hex nuts onto the exposed threads and tighten with a 9/16” socket.
Proceed to 6.10

6.10 Mounting the Octal Tube Sockets

Step 1 – Prior to mounting, slightly bend the solder terminals on the back of the socket outward (photo 6.10a).

CAUTION *The terminals of these sockets will break if bent too far. It is recommended to use needle nose pliers for better control when bending these terminals.*

Step 2 – Insert the three sockets from the outside of the chassis. Rotate these three sockets so that Pin 2 is closest to the chassis edge.(photo 6.10b).
Step 3 – Secure each of the three sockets to the chassis with two #6 x 1/4” screws and two #6 KEPS nuts.
Proceed to 6.11

Photo 6.10a

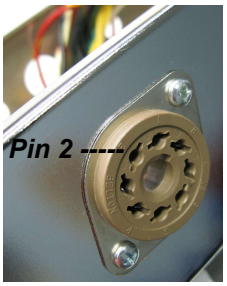


Photo 6.10b

6.11 Installing and Wiring the Speaker Jacks

Step 1 – Install a lock washer on each speaker jack and then install the two 1/4” Switchcraft 11A jacks into the appropriate speaker jack chassis holes.
Step 2 – Align the jacks in the chassis with “tip” terminals facing each other (as shown in photo 6.11a).

Step 3 – Place the flat washer on the outside of the chassis and then install and tighten the hex nuts with a 1/2" socket.

NOTE *Various output transformers are available with this kit. The wire colors differ between these transformers. Refer to **appendix F** and / or the TubeDepot online resources for appropriate installation instructions.*

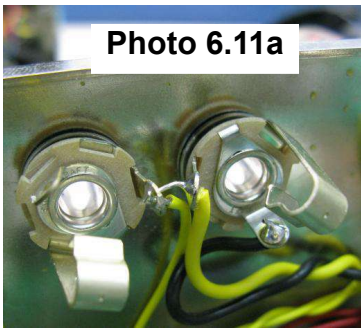


Photo 6.11a

Step 4 – Locate the output transformer secondary wires (either a black wire and green wire; black wire and yellow wire; or possibly even black, yellow, and green wires.). Trim to length and solder the black wire to the grounding terminal of the jack nearest the power tube sockets (photo 6.11a).

See appendix "F" for additional output transformer wiring options

Step 5 – Run the 8 ohm tap wire to the output jacks and trim to length.
Step 6 – Strip (1/4") and tin this 8 ohm tap wire.
Step 7 – With the 8 ohm tap wire, connect the two positive (tip) terminals of the speaker jacks together (photo 6.11a).
Step 8 – Do not solder these wires just yet,. There is one more wire to add in a future step (the yellow wire from the board as seen in photo 6.11a). **Proceed to 6.12**

6.12 Mounting the 9 pin Tube Sockets

Step 1 - Prior to mounting the preamp tube sockets, slightly bend the solder terminals 1 - 3 and 6 – 9 outward, leaving pins 4 and 5 alone for now.

CAUTION *The terminals of these sockets will break if bent too far. It is recommended to use needle nose pliers for better control when bending these terminals.*

Step 2 – Carefully bend terminals 4 and 5 together. The holes of these terminals should meet close to flush against each other (photo 6.12a).
Step 3 – To provide a flat surface for the mounting screws, use a pair of needle nose pliers to carefully bend the edges of the shield near the screw mounting holes in toward the socket (photo 6.12b, c, and d).

photo 6.12a

Before installing these sockets into the chassis, choose either traditional mounting or shock mounting. The conventional option (6.12.1) is to install the sockets directly to the chassis with screws. However, shock mounting the sockets (6.12.2) with rubber grommets, will greatly reduce the effects of tube microphonics.

photo 6.12b

photo 6.12c

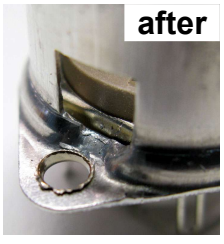


photo 6.12d

6.12.1 traditional socket installation

Step 1 – Insert the V2 tube socket from the outside of the chassis. Rotate so that pin 8 of the socket is closest to the chassis edge.
Step 2 – Insert a #6 x 1/4" screw into each mounting hole of the V2 socket. Secure the tube socket with two #6 KEPS nuts tight against the chassis.
Step 3 – Insert the V1 tube socket from the outside of the chassis and rotate the socket so that pin 8 of the tube is closest to the chassis edge (photo 6.12e).

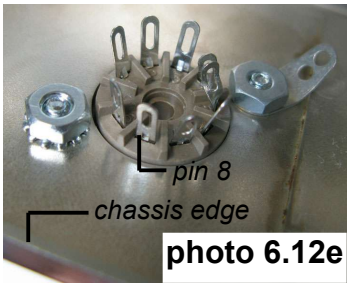


photo 6.12e

Step 4 – Insert a #6 x 1/4” screw into the mounting hole of the V2 socket nearest the chassis edge. Secure this screw with a #6 KEPS nuts.
Step 5 – Bend a #6 solder tab at a slight angle.
Step 6 – Insert a #6 x 1/4” screw into the remaining mounting hole of the V1 socket.
Step 7 – Install the #6 solder tab and #6 nut (not a KEPS nut) (photo 6.12e). Tighten firmly.
Proceed to 6.13

photo 6.12f

Photo 6.12g

6.12.2 shock mounted V1 socket installation

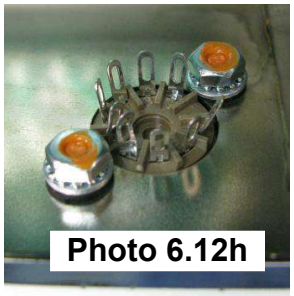


Photo 6.12h

Step 1 – With a 1/4” drill bit (a step bit is excellent for this), enlarge the preamp tube socket mounting holes in the chassis (photo 6.12f). Smooth edges of holes (remove burrs) with a deburring tool or larger drill bit.
Step 2 – Insert the small grommets in these holes (photo 6.12g) making sure they are properly seated and the hole in the center is clear.
Step 3 – Insert the tube socket from the outside of the chassis and rotate the socket so that pin 8 of the tube is closest to the chassis edge.
Step 4 – Insert a #6 x 3/8” screw into mounting holes of the socket.
Step 5 – Install a #6 flat washer on each of the exposed screws.
Step 5 – Install a #6 solder tab on the screw nearest the chassis edge and secure with a standard #6 nut (not a KEPS nut).
Step 6 – Install a #6 KEPS nut on the remaining screw and tighten.
Step 7 – Seal both nuts with fingernail polish (photo 6.12h).
Step 8 – Strip and tin ends of a 3” length of 20AWG black wire.
Step 9 – Solder one end of this 3” wire to the above solder tab (drawing 16.14c).
Proceed to 6.13

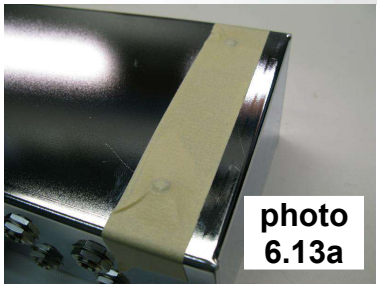


photo 6.13a

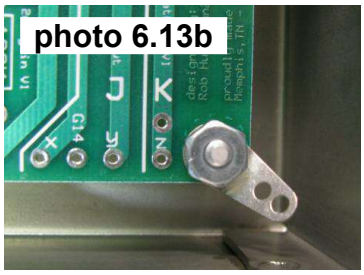


photo 6.13b

6.13 Installing the Electronics Assembly

Step 1 – Install the four #6 x 1/2” bolts into the drilled holes.
Step 2 – With masking tape, tape down the heads of these screws to the chassis to hold them in place (photo 6.13a).
Step 3 – Turn chassis over and install the four 1/4” nylon standoffs onto the four #6 x 1/2” bolts.
Step 4 – Mount the electronics assembly onto the four #6 X 1/2” bolts and standoffs, each hole of the board corresponding to a bolt. Orientate the board with the filter caps toward the power transformer.

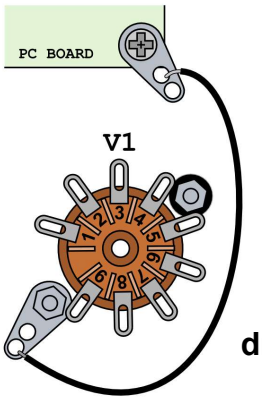
6.13.1 PCB with traditional tube socket installation

Step 1 – Apply the four #6 KEPS nuts on the exposed four #6 x 1/2” bolts and tighten them down finger tight.
Step 2 – Remove the masking tape and finish tightening the nuts down to the board.
Proceed to 6.14

6.13.2 PCB with shock mounted tube socket installation

Step 1 – Install a #6 solder tab on the board mount nearest the V1 tube socket (photo 6.13b).
Step 2 – Install a #6 standard nut (not a KEPS nut) on this screw along with the solder tab and tighten (photo 6.13b).
Step 3 – Install three #6 KEPS nuts on the remaining three #6 screw mounts and tighten.

Step 4 – Remove the masking tape and finish tightening the nuts down to the board.
Step 5 – Locate the 3” wire attached to the V1 tube socket solder tab. Solder the opposite end of this wire to the PC board mounted solder tab from step 1 above. This grounds the frame of V1 tube socket (drawing 6.13c).
Proceed to 6.14



drawing 6.13c

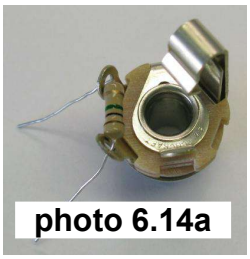


photo 6.14a

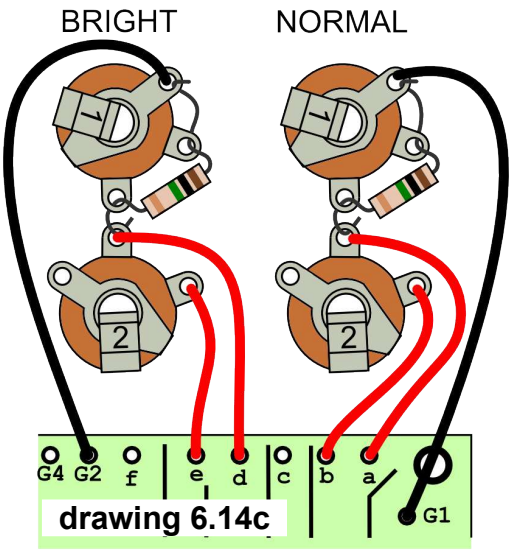
6.14 Mounting and Wiring the Input Jacks

Step 1 – With the 1M resistor (brown, black, green, gold), bend both leads and insert this resistor between the “tip” and the shorting contact terminals of jack 1. Situate resistor on the inside of the jack (photo 6.14a).
Step 2 – Run the component lead coming from the shorting contact terminal over to the “sleeve” or ground terminal (photo 6.14b).
Step 3 – Thread the remaining component lead coming from the “tip” terminal over to the second jack's “shorting switch” terminal (drawing 6.14b).
Step 4 – Tack solder the two terminals of these two jack together. Leave room for attaching another wire later on (drawing 6.14b).
Step 5 – Repeat the above for the other two input jacks. Creating two assemblies.

photo 6.14b

NOTE *Two of the four input holes on the outside of the chassis can be used as a temporary holding place and spacing template while working with the input jacks. In this way, the proper spacing is guaranteed when soldering the jacks together (photo 6.14c).*

Step 6 – From inside the chassis, install the first of this dual jack assembly into the normal channel chassis holes. The jack with the 1M resistor goes into input 1. The lock washers go on the inside of the chassis. Tighten down the assembly (drawing 6.14c).
Step 7 – Install the second jack assembly into the bright channel chassis holes. The jack with the 1M resistor goes into input 1. Tighten down the assembly.
Step 8 – Strip and tin the end of the black wire coming from pad “G1” and connect it to the sleeve / gnd terminal of the normal input 1 jack.
Step 9 – Strip and tin the end of the red wire coming from pad “b” and connect this wire to the “tip” terminal of the normal input 2 jack (drawing 6.14c).
Step 10 – Strip and tin the end of the red wire coming from pad “a” and connect this wire to the point where the two normal jacks are soldered together.



drawing 6.14c

Step 11 – Strip and tin the end of the black wire coming from pad “G2” and connect this wire to the sleeve / gnd terminal of the bright input 1 jack (drawing 6.14dc).
Step 12 - Strip and tin the end of the red wire coming from pad “e” and connect this wire to the “tip” terminal of the bright input 2 jack (drawing 6.14c)
Step 13 - Strip and tin the end of the red wire coming from pad “d” and connect this wire to the point where the two bright jacks are soldered together (drawing 6.14c).
Proceed to 6.15

6.15 Wiring the Ground Buss

Step 1 – With a small knife, scratch a spot through the yellow plated coloration on the back of each potentiometer approximately 1/4" diameter in the center of each of the three mounted pots, exposing the bare metal underneath (photo 6.15a).

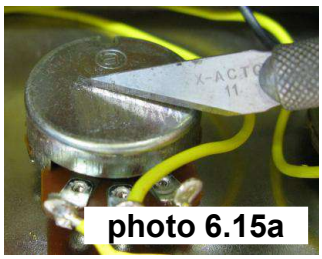


photo 6.15a

NOTE *Solder will not adhere to the protective plating used on the rear of the potentiometers. By removing a small area of the plating on exposing the underlying bare metal, solder will adhere.*

NOTE *Soldering to the back of pots is challenging because the heat from the iron is quickly absorbed by the pot leaving the tip too cold to properly apply solder. To overcome this, first apply a large bead of solder to the soldering iron tip. Allow this bead to warm for several seconds and then apply the tip with the solder bead to the surface. The excess solder on the tip will provide additional heat mass to the tip thereby improving heat transfer, making the solder adhere.*

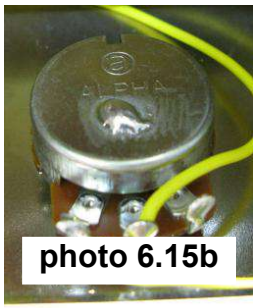


photo 6.15b

Step 2 – Apply a small bead of solder to each of these cleaned areas (photo 6.15b).
Step 3 – Start by soldering one end of the buss wire to the ground / sleeve terminal of the bright channel input 2 jack (photo 6.15c).
Step 4 – Route the buss wire across the back of each of the pots, soldering this wire in place at each spot where there is a solder bead (photo 6.15d).
Step 5 – Trim but save the excess buss wire.
Proceed to 6.16

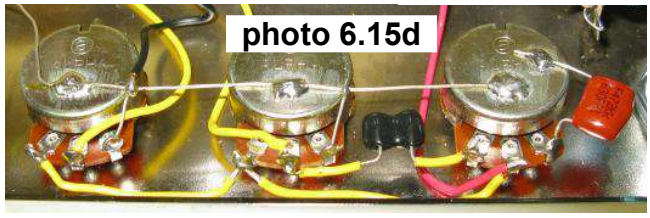


photo 6.15d

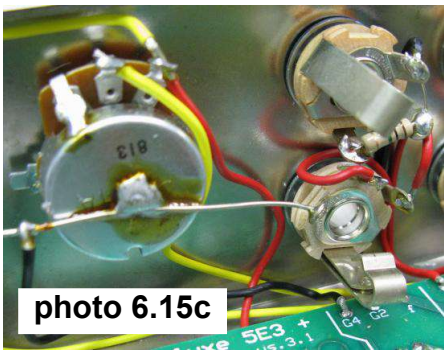


photo 6.15c

6.16 Wiring the PCB Grounds

Step 1 – Strip and tin the end of the black wire coming from pad "G7" and solder this wire to the grounding buss wire connected between the two volume controls (photo 6.15d).
Step 2 – Strip and tin the end of the black wire coming from pad "G10" and solder this wire to the #8 solder terminal secured at the power transformer nearest the fuse holder (photo 6.16a).
Proceed to 6.17

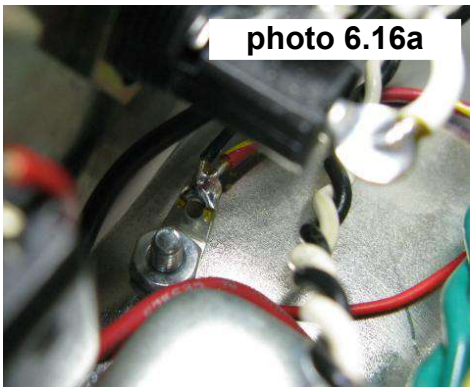


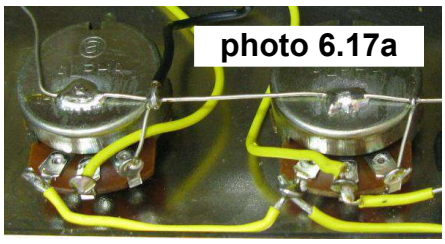
photo 6.16a

6.17 Wiring the Volume and Tone Controls

Step 1 – On the volume control nearest the input jacks (normal volume), wire a small piece of buss wire between the left terminal (as looking at the pot from the rear) to the common buss wire across the back of the controls (photo 6.17a).
Step 2 – On the bright volume control, wire a small piece of buss wire between the left terminal (as looking at the pot from the rear) to the common buss wire across the back of the controls (photo 6.17a).
Step 3 – Strip and tin the end of the yellow wire coming from pad "c" and solder this wire to

the middle terminal of the normal channel volume control (photo 6.17a and drawing 6.17b).

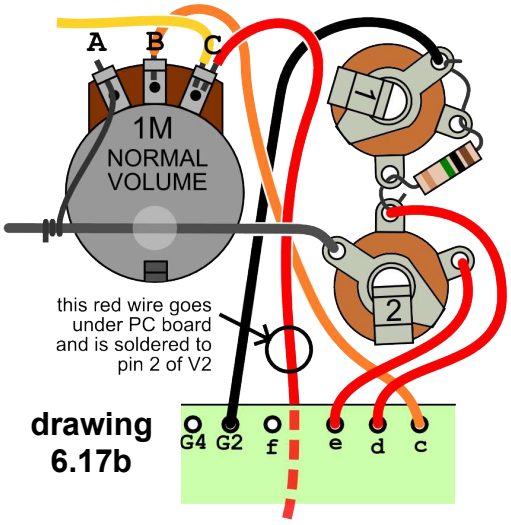
Step 4 – Strip and tin the end of the yellow wire coming from pad "f" and lightly tack this wire in place at the middle terminal of the bright channel volume control (photo 6.17a). Do not fill the terminal with solder just yet.



NOTE *"Tacking" a wire means to apply just enough solder to hold the wire in place. It is a temporary bond while waiting for some other assembly process to be completed before final soldering.*

Step 5 – Route a red 20AWG wire, 12" in length, behind the electronics assembly PC board, beginning at the volume controls and coming out between the preamp tube and the speaker output jack.

Step 6 – Strip (but do not tin) the end of the above red wire at the volume control end and insert the red wire into the outside terminal of the normal volume control nearest the input jacks (terminal "C") but do not solder just yet (drawing 6.17b).



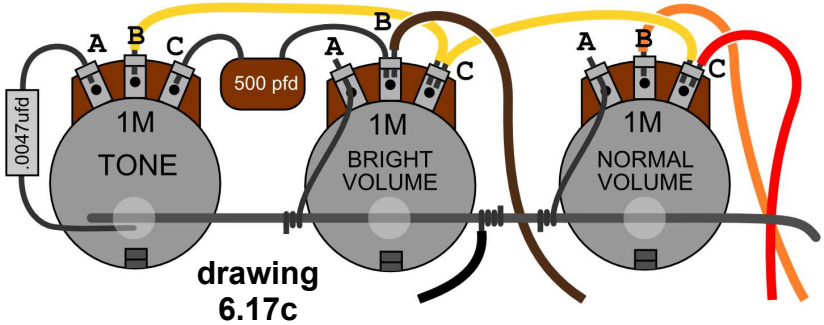
drawing 6.17b

Step 7 – Cut two pieces of yellow wire, each 2-1/2" long.

Step 8 – Strip both ends of each of these two wires but do not tin.

Step 9 – Install the first 2-1/2" wire piece into the outside terminal nearest the input jacks of the normal volume control along with the previous red wire (terminal "C"). Solder both in place (drawing 6.17b).

Step 10 – Route the other end of this yellow wire to the "C" terminal on the bright volume control (photo 6.17a). Do not solder just yet.



drawing 6.17c

Step 11 – Install the second 2-1/2" piece by inserting one end into the outer terminal of the bright volume control (terminal "C") and solder both wires in place.

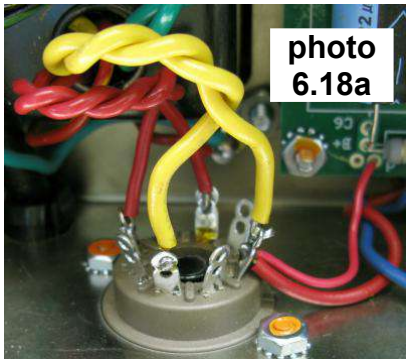
Step 12 – Route the other end of this wire to the middle terminal of the tone control (terminal "B") and solder this wire in place (drawing 6.17c).

Step 13 – Solder the 500pfd Silver Mica capacitor between the middle terminal of the bright volume control (terminal "B") and terminal "C" of the tone control (drawing 6.17c).

Step 14 – Solder the .0047 ufd capacitor between the "A" terminal of the tone control and the back of the tone control pot (drawing 6.17c).

Proceed to 6.18

6.18 Wiring the Rectifier Tube

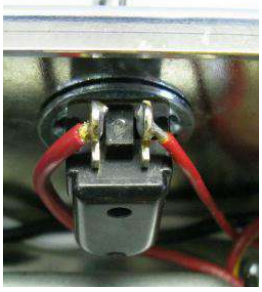


Step 1 – Strip and tin the two red wires from the power transformer. Solder these to pins 4 and 6 of the rectifier tube socket (photo 6.18a).

Step 2 – Strip and tin the two yellow wires from the power

transformer. Connect these two wires to pins 8 and 2 (top opening of pins) of the rectifier tube socket. Solder pin 2 but don't solder pin 8 just yet (photo 6.18a). There are more wires to add later.
Proceed to 6.19

photo 6.19a



6.19 Wiring the Standby Switch

Step 1 – Cut a piece of red wire 6" long and strip and tin both ends. Connect one end of this wire to pin 8 of the rectifier tube socket. Solder the wires together on this pin.
Step 2 – Connect the other end of this wire to the terminal of the standby switch nearest the chassis end (photo 6.19a).
Step 3 – Cut another piece of red wire 10" long and strip and tin both ends. Connect one end of the wire to the opposite terminal of the standby switch. Solder the other end of this wire to one of the pads labeled "i".
Step 4 – Neatly organize these wires against the chassis.
Proceed to 6.20

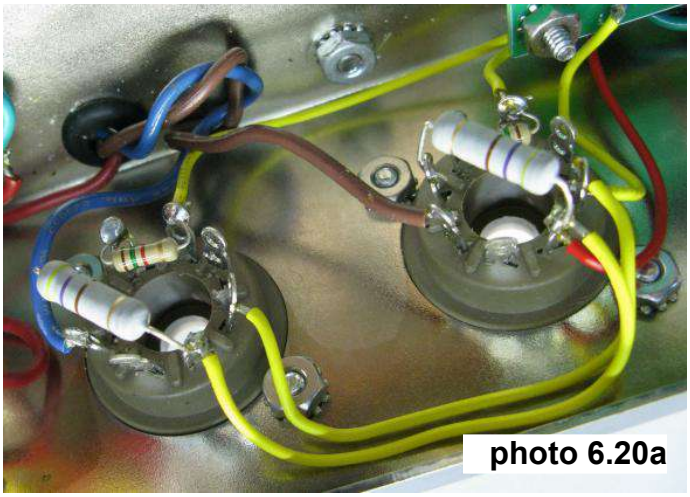


photo 6.20a

6.20 Wiring the Output Tubes

Step 1 – On the back of both power tube sockets, connect a 470 / 2 watt resistor between pin 1 and pin 4. Lightly solder (tack) in place (photo 6.20a).
Step 2 – On the back of both power tube sockets, connect a 1.5K / ½ watt resistor between pin 5 and pin 6. Lightly solder (tack) in place (photo 6.20a).
Step 3 – Connect the blue wire from the output transformer to pin 3 of the octal tube socket nearest the rectifier tube socket (photo 6.20a).
Step 4 – Connect the brown wire from the output transformer to pin 3 of the octal socket nearest the preamp tube (photo 6.20a).
Step 5 – Connect the red wire of the output transformer to pad "i" of the PC board.
Step 6 – Strip and tin the end of the wire coming from pad "j" of the PC board.
Step 7 – Solder the end of this red wire to the lower hole of pin 1 of the power tube socket nearest the preamp socket (photo 6.20a).
Step 8 – Solder the 3" wire coming from pad "h" of the pc board into the lower hole of the solder tab pin 8 of the octal socket nearest the preamp tube socket (photo 6.20a)
Step 9 – Cut two 3 ½" yellow wires. Strip and tin all ends.
Step 10 – Solder one of the above 3 ½ " wires onto pin 8 of the tube socket nearest the rectifier socket (photo 6.20a). Solder the other end of this wire to pin 8 of the other octal tube socket nearest the preamp tubes.
Step 11 – Solder the second of the above 3 ½ " wires onto pin 1 of the tube socket nearest the rectifier socket (photo 6.20a). Solder the other end of this wire to pin 1 of the other octal tube socket nearest the preamp tube socket.
Step 12 – Locate the two yellow wires coming from pads "p" and "q" of the PC board. Strip and tin the end of these wires.
Step 13 – With a permanent marker, place an identifying mark near the end of the wire

coming from pad “p”.
Step 14 – Twist these two wires tightly together and route the wires along the bottom edge of the chassis.
Step 15 – Solder the wire from pad “p” (the one with the mark) to pin 6 of the octal socket nearest the rectifier tube socket.
Step 16 – Solder the wire from pad “q” to pin 6 of the octal socket nearest the preamp tube socket.
Step 17 – Neatly organize all wires against the chassis.
Proceed to 6.21

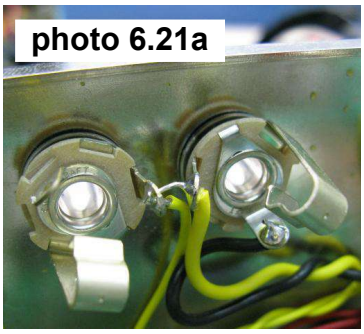


photo 6.21a

6.21 Wiring the feedback wire to speaker output jacks

Step 1 – Strip and tin the end of the yellow wire from pad “t”.
Step 2 – Connect this wire to the point where the two speaker output jack tabs are joined (photo 6.21a) and solder in place.
Proceed to 6.22

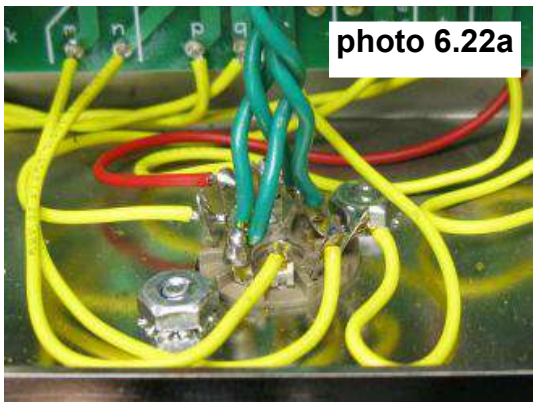


photo 6.22a

6.22 Wiring the V2 Preamp Tube

Step 1 - Trim, strip and tin the yellow wire from pad “m”. Solder this wire to pin 7 of the preamp tube socket V2 (photo 6.22a).
Step 2 - Trim, strip and tin the yellow wire from pad “n”. Solder this wire to pin 8 of the preamp tube socket V2 (photo 6.22a).
Step 3 - Trim, strip and tin the yellow wire from pad “r”. Solder this wire to pin 6 of the preamp tube socket V2 (photo 6.22a).
Step 4 - Trim, strip and tin the yellow wire from pad “s”. Solder this wire to pin 1 of the preamp tube socket V2 (photo 6.22a).
Step 5 - Trim, strip and tin the red wire routed from the tone control behind the PC board coming out between V2 and the speaker jack. Solder this wire to pin 2 of the preamp tube socket V2 (photo 6.22a).
Step 6 - Trim, strip and tin the yellow wire from pad “u”. Solder this wire to pin 3 of the preamp tube socket V2 (photo 6.22a).
Step 7 – Neatly organize wires against the chassis.
Proceed to 6.23

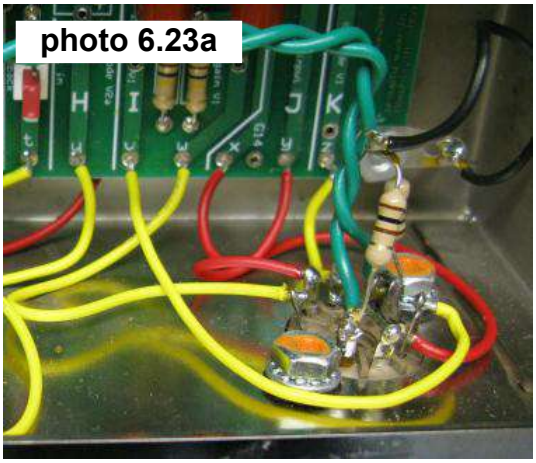


photo 6.23a

6.23 Wiring the V1 Preamp Tube

Step 1 – Solder a short piece of buss wire between pins 8 and 3 of V1 (photo 6.23a). Tack this wire in place at pin 3 for now.
Step 2 - Trim, strip and tin the yellow wire from pad “v”. Solder this wire to pin 6 of the preamp tube socket V1 (photo 6.23a).
Step 3 - Trim, strip and tin the yellow wire from pad “w”. Solder this wire to pin 1 of the preamp tube socket V1 (photo 6.23a).
Step 4 - Trim, strip and tin the red wire from pad “x”. Solder this wire to pin 7 of the preamp tube socket V1 (photo 6.23a).

Step 5 - Trim, strip and tin the red wire from pad “y”. Solder this wire to pin 2 of the preamp tube socket V1 (photo 6.23a).
Step 6 - Trim, strip and tin the yellow wire from pad “z”. Solder this wire to pin 3 of the preamp tube socket V1.
Step 7 – Neatly organize all wires tightly against the chassis (photo 6.23a).
Proceed to 6.24

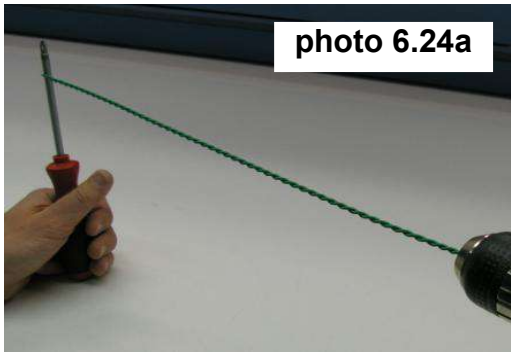


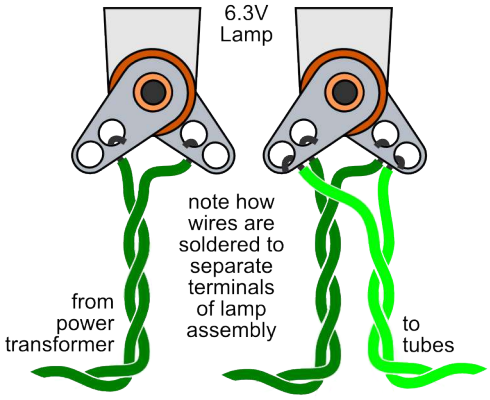
photo 6.24a

6.24 Installing and Wiring the Filaments

Step 1 – Fold the 18 AWG length of green wire in half and twist the two ends together. Lay this twisted wire to the side for now.

NOTE *To get a very even twist as well as to speed up the process, use a handheld drill to twist the two halves together. Place the loose wire ends into a drill and slide the opposite loop around a screwdriver (photo 6.24a) and let the drill slowly rotate. Twist until tight.*

Step 2 – Twist the two green wires from the power transformer together. Trim these twisted wires to 6” from the transformer. Save the excess wire.
Step 3 – Strip and tin the ends of the green wires from the transformer. Solder these wires on the two inside holes of the terminals of the indicator lamp (drawing 6.24b).



drawing 6.24b

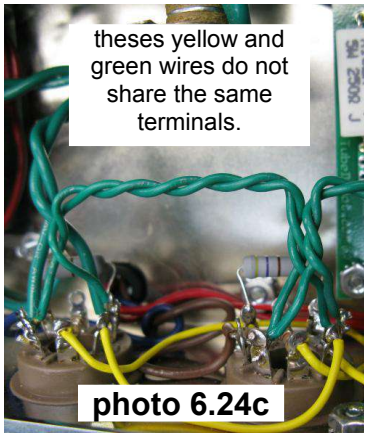
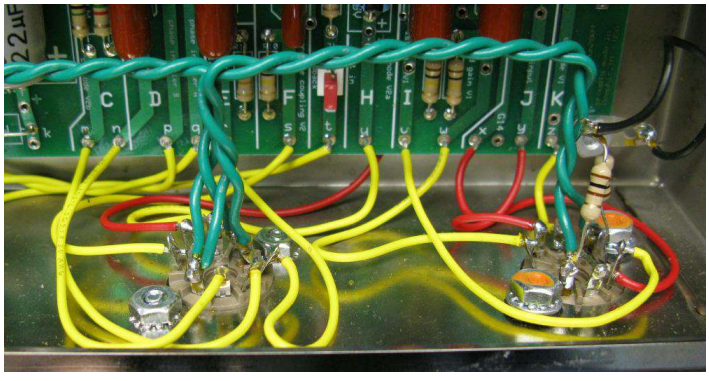


photo 6.24c

Step 4 – Strip and tin the ends of the left over green wires and solder these wires to the outside mounting holes of the indicator lamp (drawing 6.24b).
Step 5 – Strip and tin the free ends of the wires from the indicator lamp and tack solder in place to pins 2 and 7 of the tube socket nearest the rectifier tube socket (photo 6.24c).
Step 6 – With the twisted 18 AWG wire from step 1, unwind about 1” from the cut ends of this twisted wire. Strip and tin these ends and connect to pins 2 and 7 of the octal tube socket nearest the rectifier socket. Solder these wires in place.



Step 7 – Neatly route the twisted wire pair to the next octal socket. Trim to length, strip and tin these ends and tack them in place on pins 2 and 7 of the next tube socket.
Step 8 – Untwist 1” from the cut ends of the twisted pair wires. Strip and tin these ends and solder (along with other wires) to pins 2 and 7 of the second power tube socket (photo 6.24c).

NOTE *On both 9 pin preamp tube sockets, pins 4 and 5 are wired together. This is accomplished by inserting the tinned end of the filament wires through both of these pins. Apply solder only after both wire ends are inserted through these holes.*

Step 9 – Neatly route this twisted wire pair to the 9 pin preamp tube socket on the opposite side of the speaker jacks (socket V2). Trim wire to length, strip and tin these ends and tack them in place to pins 9 and pins 4 and 5 of this tube socket (photo 6.24d).

photo 6.24e

Step 10 – Untwist 1” from the cut ends of the twisted pair wires. Strip and tin these ends and solder (along with other wires) to pins 9 and pins 4 and 5 of the above preamp tube socket (V2).

Step 11 – Neatly route the twisted wire pair to the next 9 pin preamp tube socket (V1). Trim to length, strip and tin these ends and tack them in place to pins 9 and pins 4 and 5 of the first tube socket (V1).

photo 6.24f

Step 12 – Take two 100 ohm resistors and twist the two leads together (photo 6.24e).

Step 13 – Bend the end of the other two opposite leads of the resistors away from each other (6.24e).

Step 14 – Connect these two bent resistor ends along with the filament wires to pins 9 and 4/5 (photo 6.24f) and solder.

Step 15 – Trim the twisted ends of the resistors to half their length and bend a small loop in these twisted ends.

Step 16 – Cut a 3” length of black wire. Strip and tin both ends.

Step 17 – Solder one end of this black wire to the loop of the two resistors (photo 6.24f).

Step 18 – For the standard tube socket mount, solder the other end of this black wire to the solder tab mounted to the screw of the preamp tube (photo 6.24f). For shock mounting of preamp tube, this black wire is soldered to the terminal connected to the corner mount of the PC board (photo 6.24g).

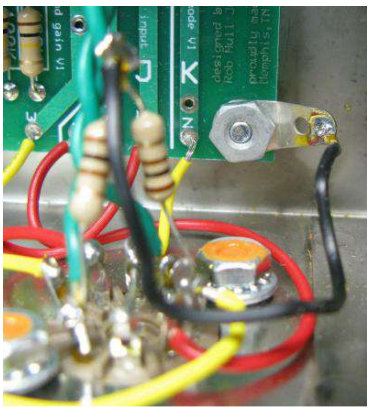


photo 6.24g

Proceed to 6.25

6.25 Installing the AC Power Cord

Step 1 – locate the cut end of the power cord and strip off the outer black PVC insulation approximately 7 1/2” from the end.

CAUTION *The black PVC jacket of the power cord is thin and very easily cut. Be very careful not to cut so deep as to accidentally cut the insulation of the inside wires.*

Step 2 – With the three wires (white, green and black) exposed, trim the white wire to a length of 5”, the green wire to 4” and leave the black wire at 7 1/2” length.

Step 3 – Wrap the strain relief around the black PVC jacket of the power cord approximately 1” from where the stripped jacket begins. Note the alignment of the strain relief (photo 6.25a).

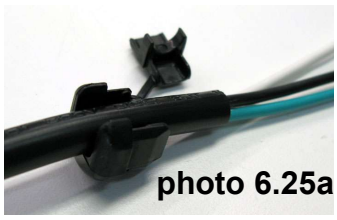


photo 6.25a

photo 6.25b

Step 4 – With a pair of slip joint pliers, firmly squeeze the strain relief into place around the power cord then grasp the strain relief and feed the stripped end of the power cord wires into the

corresponding hole in the chassis.
Step 5 – While still grasping the strain relief with the pliers, guide the strain relief into the chassis hole. Firmly press the compressed strain relief into the chassis hole (photo 6.25b).

NOTE *There is a specific tool that makes installing strain reliefs simple. If you find yourself installing strain reliefs on a regular basis, this tool is worth owning. See TubeDepot.com p/n TL-R-29*

Step 6 – Once the strain relief is installed, pull on the power cord to verify that it is indeed firmly mounted.
Proceed to 6.26

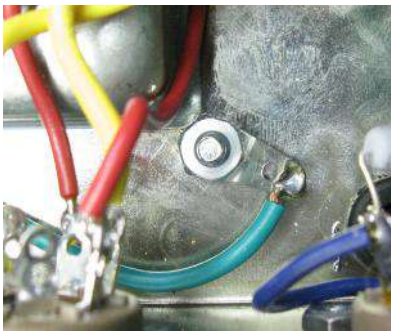


Photo 6.26a

6.26 Wiring the AC Power Cord Ground

Step 1 – Loosely route the green wire from the AC cord to the #8 solder terminal nearest the rectifier tube socket (photo 6.26a).
Step 2 – Trim to length. Strip and tin the end of the remaining green wire of the AC power cord.
Step 3 – Solder this green wire to the #8 solder terminal nearest the rectifier tube socket.
Proceed to 6.27

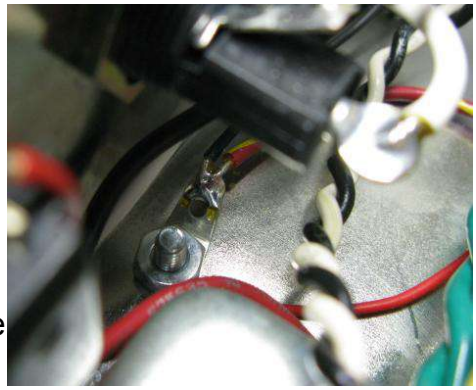


Photo 6.27a

6.27 Wiring Power Transformer Center Tap

Step 1 – Locate and untwist the red wire with yellow stripe from the wire bundle coming from the power transformer.
Step 2 – Loosely route this wire from the transformer to the #8 solder terminal located nearest the rectifier tube socket.
Step 3 – Trim to length. Strip and tin the end of this red wire with yellow stripe coming from the power transformer.
Step 4 – Connect this wire to the shared #8 solder terminal nearest the power switches and solder wires to this terminal (photo 6.27a).
Proceed to 6.28

6.28 Wiring the Fuse Holder

WARNING *By wiring the fuse holder as recommended, shock hazards associated with changing a fuse are reduced because the source AC is at the far end of the fuse holder and not at the cap end.*

Step 1 – Wire the “HOT” of the AC mains power cord (black wire in the USA) to the end terminal of the fuse holder (video and photos show incorrect white wire here).
Step 2 – Cut a 3” piece of 18awg black wire. Strip and tin each end.
Step 3 – Solder one end of this wire to the remaining solder terminal of the fuse holder.
Proceed to 6.29

6.29 Wiring the Power Switch

Step 1 – Solder the other end of the above black wire coming from the fuse holder to the left terminal of the power switch.
Proceed to 6.30

Dual Primary Power Transformer Installation Instructions. Choose the installation appropriate for your mains supply voltage (120V or 240V).

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6.30a Wiring the Power Transformer for 120V Mains

CAUTION

*It is important to choose the correct primary wires based on the mains voltage appropriate to your location in the world. Incorrect wiring can lead to power transformer damage and/or fire hazards. The following instructions are for wiring the dual primary transformer for **120V** mains. Instructions for 240V mains is in the following section (6.30b).*

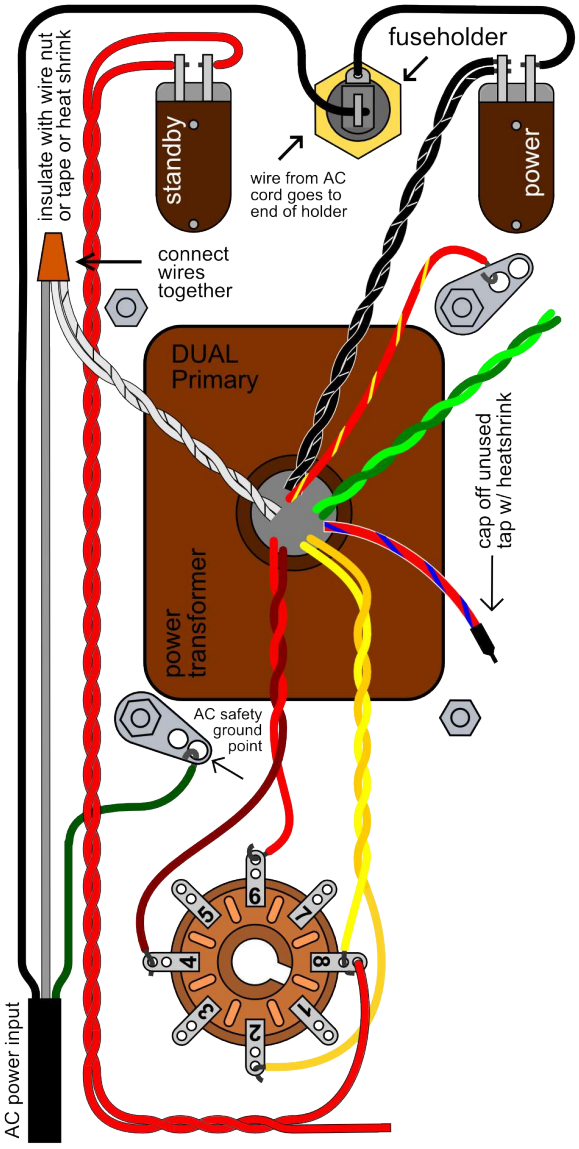
Step 1 – From the power transformer, locate the white wire and the white with black stripe wire. Twist the length of these two wires together and strip the ends of both.
Step 2 – Strip the end of the "NEUTRAL" wire of the AC power cord (white wire in the USA).
Step 3 – Twist the stripped ends of the above three wires together and solder. Cap the end of these twisted wires with either a wire nut or heat shrink. Make sure that no bare wire is showing.
Step 4 – From the power transformer, locate the black wire and the black with white stripe wire. Twist the length of these two wires together.
Step 5 – Neatly run the black and black with white stripe twisted wires over to the power switch and cut to length. Strip the ends of both wires.
Step 6 – Insert these stripped wire ends into the open terminal of the power switch and solder.
Step 7 – Cover the end of unused red with blue stripe wire with heat shrink or electrical tape.
Step 8 – Neatly arrange all wires close to the chassis (see drawing 6.30a on following page).
Proceed to Chapter 7

6.30b Wiring the Power Transformer for 240V Mains

CAUTION

*It is important to choose the correct primary wires based on the mains voltage appropriate to your location in the world. Incorrect wiring can lead to power transformer damage and/or fire hazards. The following instructions are for wiring the dual primary transformer for **240V** mains. Instructions for 120V mains is in the previous section (6.30a).*

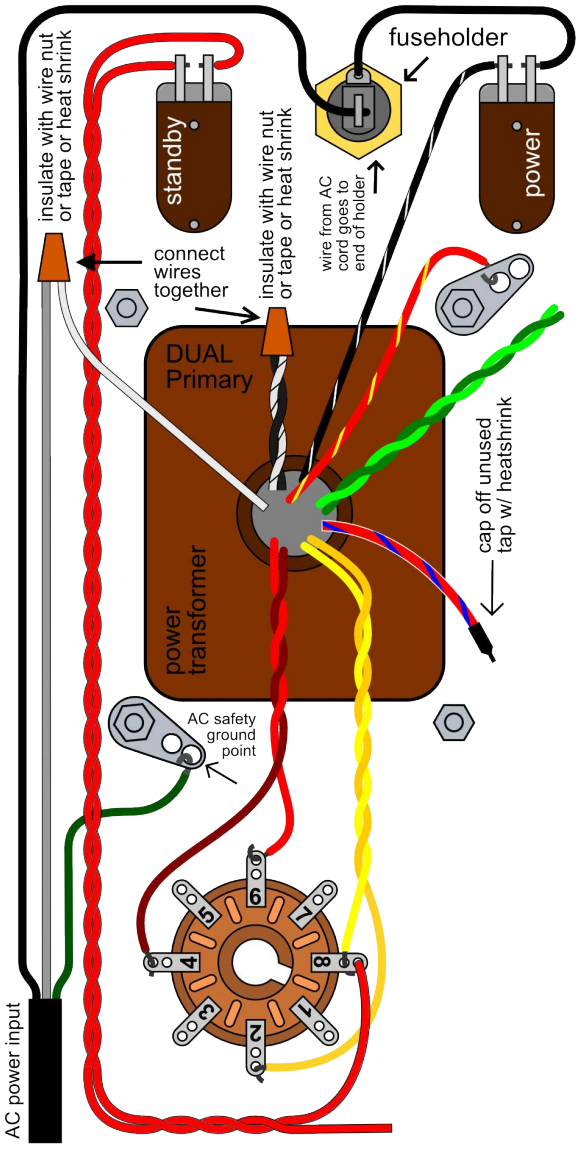
Step 1 – From the power transformer, locate and strip the end of the white wire.
Step 2 – Strip the end of the "NEUTRAL" wire of the AC power cord.
Step 3 – Twist the ends of the above two wires together and solder. Cap the end of these twisted wires with either a wire nut or heat shrink. Make sure that no bare wire is showing.
Step 4 – From the power transformer, locate the black wire and the white with black stripe wire. Twist the length of these two wires together. Strip the ends of both wires.
Step 5 – Twist the stripped ends of the black wire and white with black stripe wires together and solder. Cap the end of these twisted wires with either a wire nut or heat shrink. Make sure that no bare wire is showing.
Step 6 – From the power transformer, locate the black with white stripe wire.
Step 7 – Neatly run this wire to the power switch and cut to length. Strip the end of this wire.
Step 8 – Insert the stripped wire end into the open terminal of the power switch and solder.
Step 9 – Cover the end of unused red with blue stripe wire with heat shrink or electrical tape.
Step 10 – Neatly arrange all wires close to the chassis (see drawing 6.30b on following page).
Proceed to Chapter 7



120V Mains

http://tubedepot.com/kit-tweeddeluxe.html

drawing 6.30a


fuseholder
insulate with wire nut or tape or heat shrink
standby
power
insulate with wire nut or tape or heat shrink
wire from AC cord goes to end of holder
connect wires together
DUAL Primary
power transformer
cap off unused tap w/ heatshrink
AC safety ground point
AC power input

240V Mains

drawing 6.30b

Tweed 5E3+

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7 Final Assembly

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7.1 Installing the Knobs

Step 1 – Rotate the shafts of the controls on the front of amp fully counter clockwise
Step 2 – with a small screwdriver, loosen the set screw of the first knob
Step 3 – Place this knob on to the first control shaft.
Step 4 – Align the pointer of the knob to the “1” position printed on the chassis.
Step 5 – firmly tighten the set screw of the knob to the shaft.
Step 6 – Repeat for remaining knobs and shafts.

7.2 Installing the Chassis Mounting Bolts and Chassis

Step 1 – Press the two truss bolts into the cabinet holes (if not already installed).
Step 2 – Place the amp on the floor onto it's front with the speaker magnet facing up.
Step 3 – Mount the chassis onto the truss bolts, sliding the chassis against the cabinet top.
Step 4 – Install the two #10 KEPS nuts, one on each bolt, and finger tighten the chassis against top of cabinet.
Step 5 – Pick the face of the amp off of the floor and stand amp up right.
Step 6 – With the nuts on loosely, slide the chassis to the rear of cabinet, away from speaker.
Step 7 – Press back panel into position, pushing the chassis against the panel. This will properly align the chassis with in the cabinet and provide good contact with the shielding foil.

NOTE *Proper alignment of chassis within cabinet is when the chassis contacts the back panel shielding tape without distorting the back panel.*

Step 8 – Place the back panel to the side and firmly tighten chassis into the cabinet. Do not install back panel just yet.
Proceed to 7.2

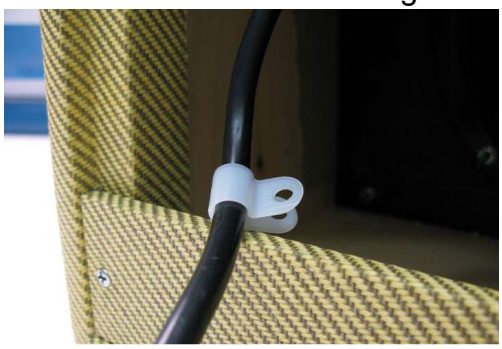


photo 7.2a

7.3 Installing AC Power Cord Clamp

Step 1 – Properly align the 5/16” nylon cable clamp around power cord (photo 7.2a).
Step 2 – With a #8 x 5/8” screw, secure the cable clamp and power cord to the inside cabinet wall. (photo 7.2b).
Proceed to Chapter 8

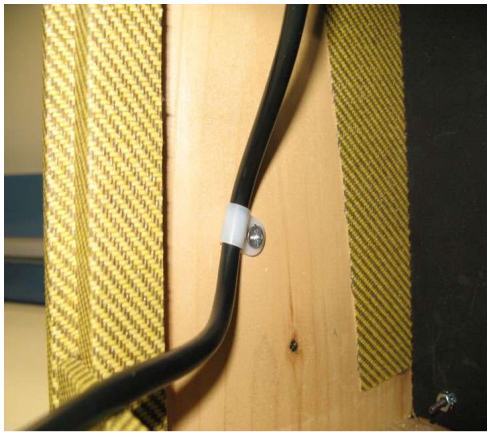


photo 7.2b

8 Testing

8.1 You are almost finished. And although the first temptation is to plug in the amp and turn it on, I recommended taking the time to review all of your work. Any errors are more likely to stand out during this time. **It is common to find two or more errors.**

After verifying the connections are correct, read all of the following steps before completing any of them. Once you have finished reading these steps, it is time to begin. All of the following voltages are measured with full 120VAC wall voltage applied.

Step 1 - Install a 2A, fast blow fuse into the fuse holder and a lamp in the lamp holder.

WARNING *When changing or installing a fuse or lamp, always remove the AC source by unplugging the amp. Never use fingers to remove or insert a fuse into a fuse holder. Instead, use the fuse cap to hold the fuse when removing or inserting into the holder.*

CAUTION *Use of any fuse larger than 2A is not recommended and could cause severe and costly equipment damage in case of an internal component failure.*

Step 2 – **With the amp unplugged and no tubes installed**, turn on the amplifier's power and standby switch (or in this case the “ground” switch, turned toward the word “ground” on the chassis).. The power and standby switches will remain on until all tests are finished.

NOTE *I personally recommend using a variable AC with separate current and voltage meters. This allows bringing the voltages up very slowly and provides more accurate monitoring capabilities.*

NOTE *If you are uncomfortable with just turning on the amp and watching for smoke, I recommend building an inexpensive Dim-Bulb tester to monitor and control current flow into the amp. A quick internet search on “Dim Bulb tester” will give several diagrams and plans.*

CAUTION *It is good practice to use a power strip with a circuit breaker and an on/off switch between the wall power and the amplifier power cord as an improved electrical safety measure.*

WARNING *In case of any troubles, quickly disconnecting the power cord from the wall (or turn off the power strip). You should not touch the amp or the amp's power switch until the amplifier's power cord is no longer connected to AC wall power.*

Step 3 – Plug the amp's AC power cord into AC power at the wall.
Step 4 – The panel indicator should illuminate. Monitor for any smoke, unusual odors or a blown fuse or physically hot power transformer. If anything unusual occurs, disconnect power immediately and review connections.
Step 5 – If there is nothing unusual after a couple of minutes, remove AC power by disconnecting the AC power cord from the AC source. Leaving the amp's power switch “on”.
Step 6 – With the amp still disconnected from AC power, install the tube rectifier.
Step 7 – Plug the amplifier's AC power cord into the AC power source at the wall.
Step 8 – The panel indicator should illuminate. Visually verify that the filament inside the rectifier tube is glowing. Monitor the amplifier for any smoke, unusual odors or blown fuse. If anything unusual occurs, disconnect power immediately and review connections.

NOTE *Within a minute or two, the rectifier will have heated up and provided a slowly increasing high voltage to the power supply. This voltage will properly form the high voltage filter caps.*

Step 9 – With your multimeter on the 500 volt DC range, connect the meter's black lead to chassis ground (photo 8.1a) and carefully connect the red lead to the positive end of C12

(B+). The voltage here should be something close to +460 +/- 10 volts (photo 8.1b).

WARNING *Whenever testing voltages, it is recommended to keep your free hand off of the chassis. In this way, there isn't a path for significant current to flow through the body to ground in case the measuring hand accidentally comes in contact with high voltages.*

NOTE *These voltages are being measured without power and preamp tubes installed. These values will decrease with the added load of the tubes.*

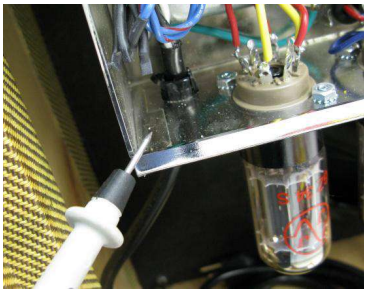


Photo 8.1a

Photo 8.1c

photo 8.1b

Step 10 – Remove AC power by disconnecting the AC power cord from the AC source.
Step 11 – Install both preamplifier tubes.
Step 12 – Plug the amplifier's AC power cord into the AC power source at the wall.
Step 13 - The panel indicator should illuminate. Monitor for any smoke, unusual odors, or blown fuse.
If anything unusual occurs, disconnect power immediately and review connections.
Step 14 – Let the amplifier warm up for 2 minutes. With a multimeter on the 20 volt range, carefully connect the meter's black lead to chassis ground and the red lead to the positive side of C3. The voltage here should be close to +1.5 +/- .5 volts (photo 8.1c).

NOTE *The presence of voltages at steps 14 & 15 indicates that V1 and V2 are correctly sourcing current.*

photo 8.1d

photo 8.1e

Step 15 – Move the red lead to the positive side of C6. The voltage here should be close to +1.5 +/- .5 volts (photo 8.1d).
Step 16 – Move the red meter lead to the lower lead of resistor R14. The voltage here should read +63V +/- 2.0V volts.
Step 17 – If these measurements are correct, remove the AC power by disconnecting the AC power cord from the AC source.
Step 18 – Install the two power tubes.
Step 19 – Connect speaker to either output jack.
Step 20 – Turn all volume and tone controls to minimum position with both amp switches to “on”.
Step 21 – Plug the amplifier's AC power cord into the AC power source at the wall.
Step 22 – The panel indicator should illuminate. Monitor for any smoke, unusual odors, or blown fuse. If anything unusual occurs, disconnect power immediately and review connections.
Step 23 – Let the amplifier warm for 2 minutes. With a multimeter on the 200 volt DC range,

carefully connect the meter's black lead to chassis ground and the red lead to the positive side of C10. The voltage here should read close to +22 +/- 3 volts (photo 8.1e).

NOTE *The presence of voltage at step 22 indicates that V3 and V4 are correctly sourcing current.*

Step 24 – If all the above measurements are within specifications, and the speaker is connected, and with no signal source connected to either input, turn up the volume control and listen for a low level hiss from the speaker. There will be a slight hum, but anything drastic indicates wiring troubles.
Step 25 – If the above hiss is heard, turn the volume control back to minimum and connect a signal source into input 1 of the bright channel.

NOTE *A signal source can be a guitar or high impedance microphone or even a low level CD or MP3 player. A speaker output from another amp is not recommended.*

Step 26 – Turn up the volume on the amp and the signal source (most likely a guitar or harmonica microphone) and verify that the signal is coming from the speaker.
Step 27 – If everything checks good, turn off amp and install the back panel.
Step 28 – Now the time has come to rock out … your amp is done!

END

Congratulations!

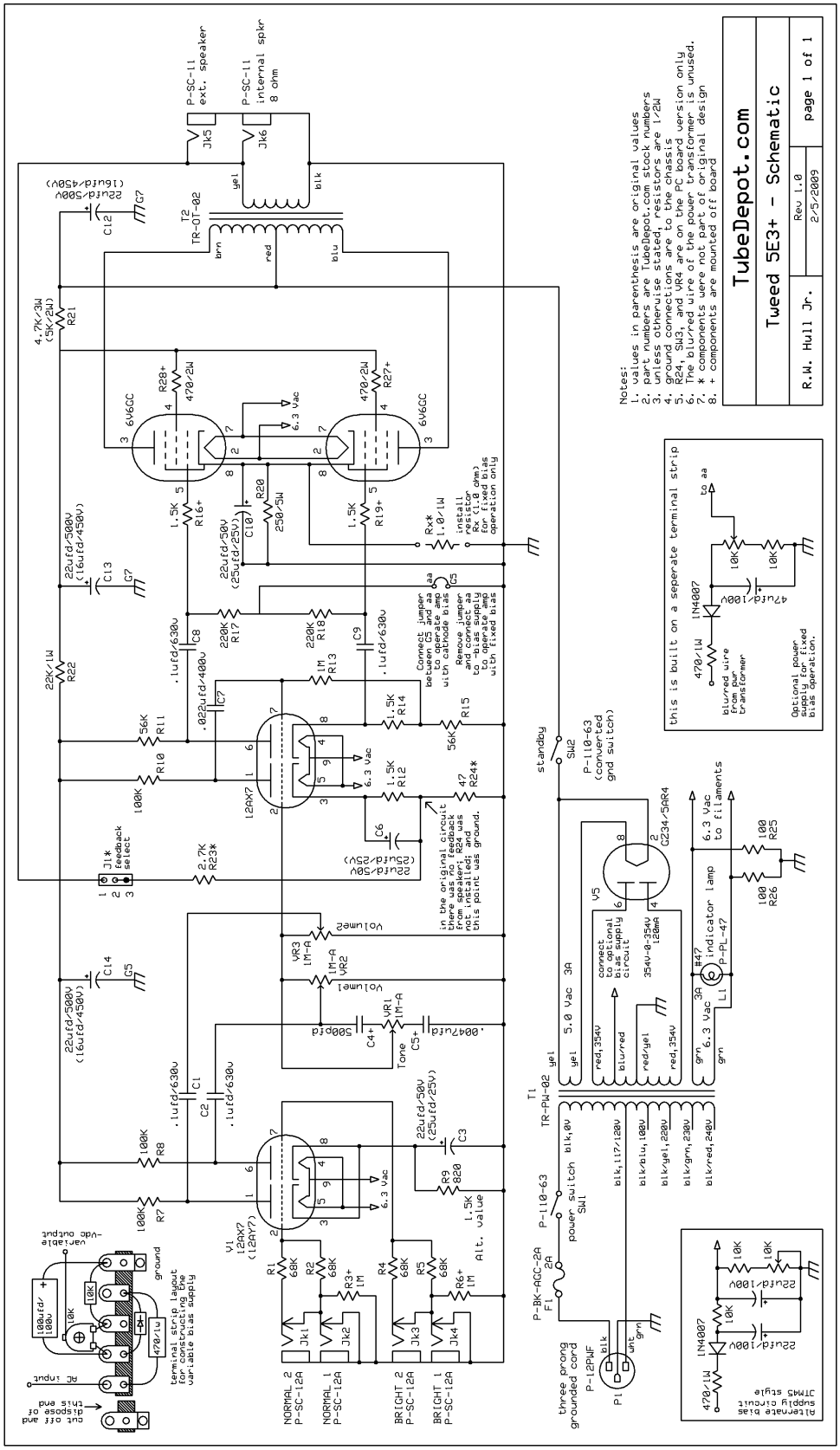
Please send me a photos of your finished amp. A couple of photos of the insides of your amp, maybe a couple photos of your work bench and of course a few photos of the amp being played by you, all of these would be greatly appreciated. Send them to me at the below address.

TubeDepot.com
c/o Robert Hull
1686 Barcrest Dr.
Memphis, TN 38134

… or to my email:

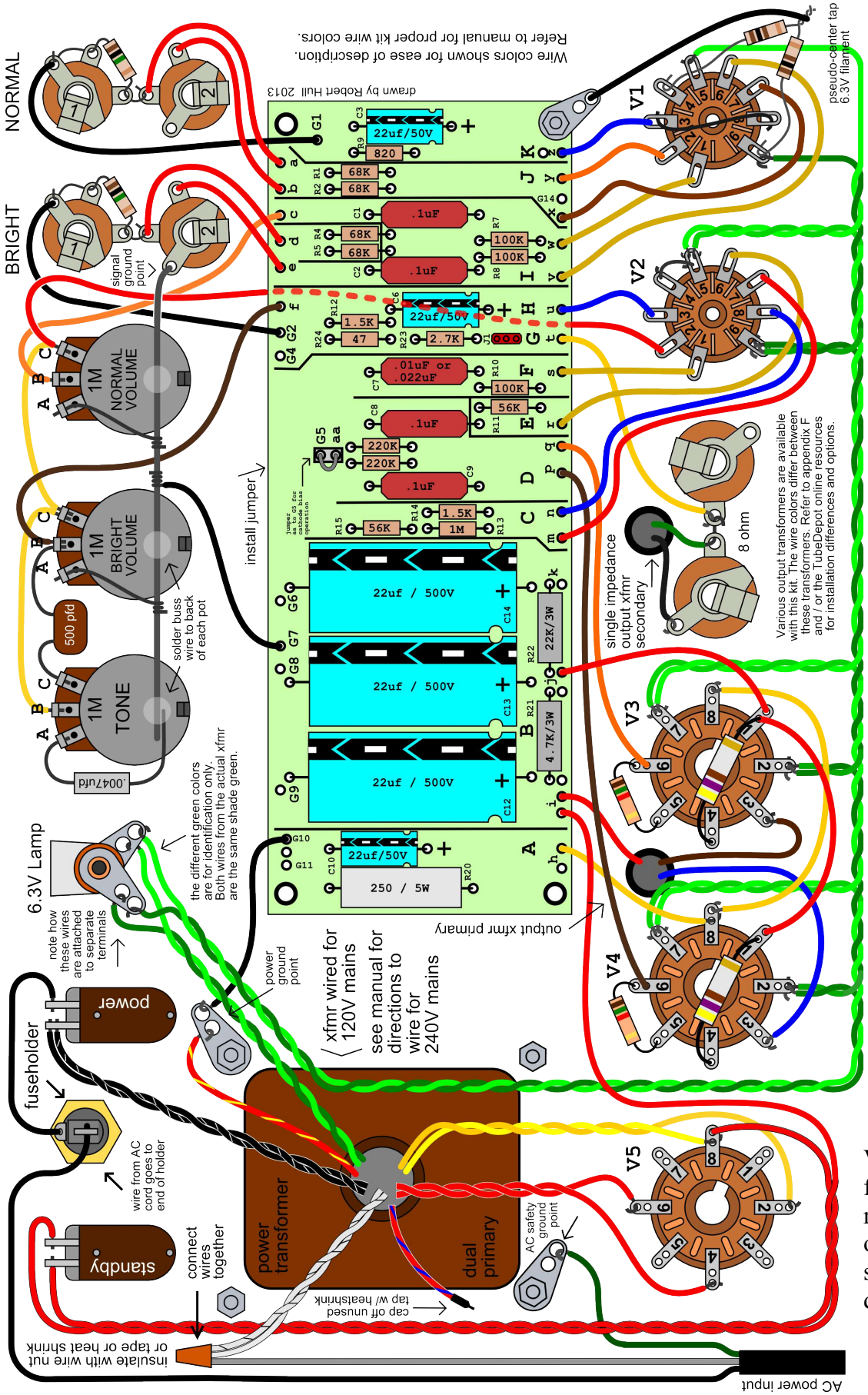
tech@tubedepot.com

Keep on playing …


TubeDepot.com
Tweed 5E3+ - Schematic
R.W. Hull Jr.
Rev 1.0
2-5-2009
page 1 of 1
Notes:
1. values in parenthesis are original values
2. part numbers are TubeDepot.com stock numbers
3. unless otherwise stated, resistors are 1/2W
4. ground connections are to the chassis
5. R24, SW3, and VR4 are on the PC board version only
6. The blu/red wire of the power transformer is unused.
7. * components were not part of original design
8. + components are mounted off board
this is built on a seperate terminal strip
Optional power supply for fixed bias operation.
Alternate bias supply circuit 1TM45 style
terminal strip layout for constructing the variable bias supply
three prong grounded cord
standby
power switch
Tone
Volume1
Volume2
Alt. value
in the original circuit there was no feedback from speaker1, R24 was not installed and this point was ground.
Connect jumper between aa and bb to operate amp with cathode bias
Remove jumper and connect aa to cc to operate amp with fixed bias
Install resistor (see chart) for fixed bias operation only
connect to optional bias supply circuit
connect to filaments
indicator lamp
NORMAL 2 P-SC-12A
NORMAL 1 P-SC-12A
BRIGHT 2 P-SC-12A
BRIGHT 1 P-SC-12A
P-SC-11 ext. speaker
P-SC-11 internal spkr 8 ohm
TR-OT-02
TR-PW-02
P-110-63
P-BK-AGC-2A
P-12PWF
P-PL-47
G234/5AR4
6V6GC
12AX7
1N4007

Visit our website for higher resolution versions of these drawings, schematics and diagrams.

Parts and Wiring Layout



Visit our website for higher resolution versions of these drawings, schematics and diagrams.

10 Cool Modifications

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Once you have the amp working and sounding good, here are a few ideas to "shape" the tone to suite your tastes.

1. Reduce low frequency muddiness when running the amp at high gain settings by changing both C1 and C2 from .1ufd to .047ufd or .022ufd or .01ufd or even .0047ufd! Make sure to change both equally.
2. Change both C8 and C9 like above. This modification will provide similar results to the above mod but since this modification appears after the phase inverter, there will be a different tonal response. Experiment with small changes to both stages vs. one large change per each stage.
3. Install 33ufd/500v or 47ufd/500v caps in C12 and C13 positions - tightens power supply and provides quicker dynamics.
4. Experiment with value of R9. Install a 1.5K resistor for better definition and controlled gain when using a 12AX7 as input tube.
5. Experiment with the value of C3 and C6. By decreasing the values from 22ufd to 10ufd all the way to 1ufd or .47ufd, the gain response of these two stages can be shaped to have reduced muddy low end gain and better defined mids and highs.
6. Pin 8 and pin 3 share a cathode bypass resistor and capacitor. By separating pin 3 and pin 8 from V1 and assigning each their own cathode circuit, additional tone shaping can be achieved (a la Marshall). Start by soldering pin 8 to the C3 / R9 circuit on the PC board. Solder the now empty pin 3 of V1 to a separate capacitor and resistor pair. Good values to choose would be 2.7K ohms for the resistor and .68 ufd for the capacitor. This gives a tight midrange response without being too bright.
7. Change out 6V6 tubes for EL84 tubes by fabricating your own cover plate adapter and installing a 9 pin tube socket – allows installing EL84s vs. 6V6. I would encourage retaining the tube rectifier when applying this modification for great "sag".
8. Change out 6V6 with 5881. This is a great spongy tube that responds extremely well when pushed hard. Because the 5881 consumes twice the filament current as compared to the 6V6, it is recommended to use a solid state rectifier in place of the tube rectifier when using 5881 tubes. By not using the tube rectifier, there is additional power transformer over head. This overhead is needed for the increased filament requirements of the 5881. The filter caps must be upgraded to +500V.
9. Install solid state rectifier in place of tube rectifier – tightens up dynamics and power output. Filter caps MUST be upgraded to +500V types. Additionally, the 6V6 tubes must be very good quality to withstand the higher plate voltages.
10. Run amp without negative feedback altogether by disconnecting feedback line from speaker output jack – provides more overall gain and distortion with the amp volume at "12". Similar to setting the feedback adjustment fully counterclockwise.
11. Build an external speaker load box to lower the wattage going to the speaker. Great for recording. And it only requires 2 resistors for the basic box (see Appendix E).
12. Wire the amp for fixed bias vs. the original cathode bias to get more power and dynamics out of the amp. The transformers will run slightly cooler as well.
13. To decrease muddy response by lowering the value of C7 to .0022, .001, or 500pF.

Appendix A

Resistor and Capacitor Codes

This project uses different types of resistors and capacitors. The diagrams below will assist you in locating and identifying values, tolerances and ratings for the various circuit requirements for your project.

Resistor Power Ratings

Not only are resistors graded by their values but also by their power ratings. Power ratings are determined by how much heat (power) can be safely dissipated by the resistor. Higher ratings are usually indicated by larger sizes.

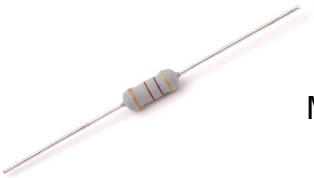
Below are photos and descriptions of various resistors that could be used in this project.

Carbon Composition 1/2W

Carbon Film 1/2W

Metalized Film 1/2W

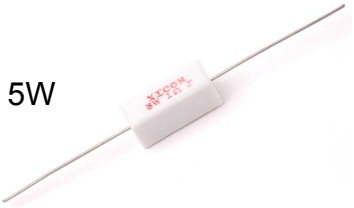
Carbon Composition 1W



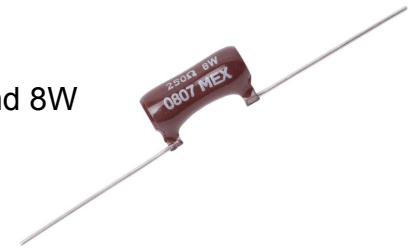
Metal Oxide 1W

Metal Oxide 2W

Metal Oxide 3W



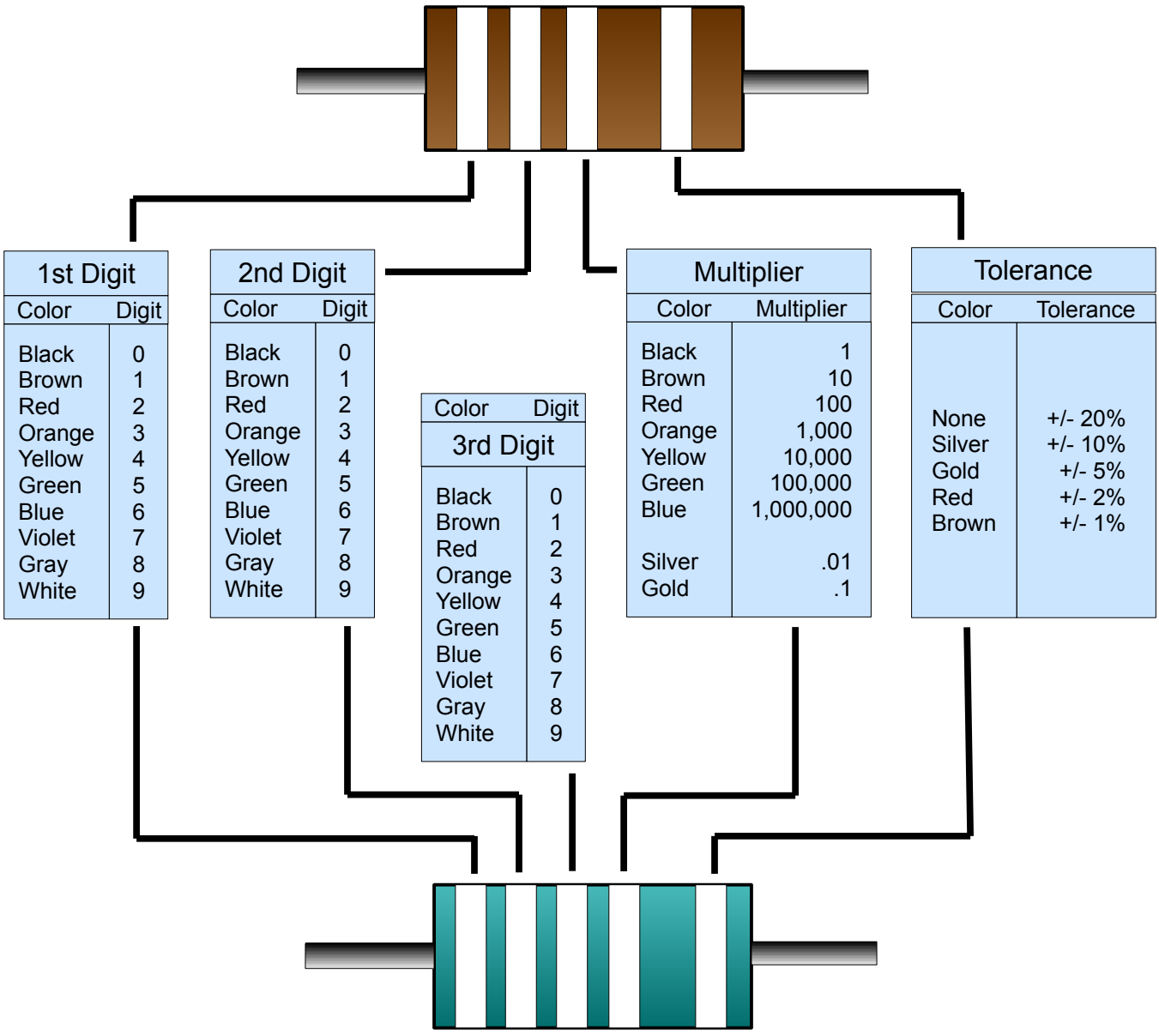
Wire Wound 5W



Wire Wound 8W

Resistor Types

Carbon Film
Metal Oxide
Carbon Composition



1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

3rd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	.01
Gold	.1

Tolerance	
Color	Tolerance
None	+/- 20%
Silver	+/- 10%
Gold	+/- 5%
Red	+/- 2%
Brown	+/- 1%

Metal Film (1%)

How to Read Capacitor Value Codes

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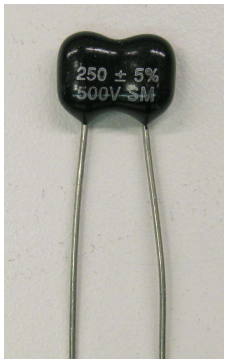
This project uses several different kinds of capacitors. Some of these capacitors have their values and voltage ratings printed on them, others use numerical codes. The diagrams below will assist you in locating and identifying capacitor values, tolerances, and voltage ratings for the various circuit requirements for your project.



Cornell-Dubilier Silver Mica – high quality / high accuracy picofarad cap

1st line: 250 +/- %5 = direct value in pfd (250pfd); tolerance 5%
2nd line: 500V SM = voltage rating (500V); batch code

Sprague "Orange Drop" 715 series – Vintage style film & foil polypropylene capacitor.

1st line: 715P600V = 715 series; rated at 600V
2nd line: 104J 0821 = value in pfd (104 = 10 and 4 zeros pfd); tolerance (J = +/- 5%); batch code

104 = .1ufd
103 = .01ufd 223 = .022ufd 473 = .047ufd
102 = .001ufd 222 = .0022ufd 472 = .0047ufd

Xicon Metalized Polypropylene – Warm tone, small size

1st line: F104K d = value in pfd (104 = 10 and 4 zeros pfd); tolerance (K = +/- 10%)
2nd line: 630MPP 1= voltage rating (630V); construction (MPP = metalized polypropylene)

104 = .1ufd
103 = .01ufd 223 = .022ufd 473 = .047ufd
102 = .001ufd 222 = .0022ufd 472 = .0047ufd

Sozo and Mallory 150 Film and Foil – Vintage style film & foil polypropylene capacitor, axial leads

1st line: 684K = value in pfd (684 = 68 and 4 zeros pfd); tolerance (K = +/- 10%)
2nd line: 160V = voltage rating (160V)
3rd line: 0834R = batch / date code

104 = .1ufd 684 = .68ufd
103 = .01ufd 223 = .022ufd 473 = .047ufd
102 = .001ufd 222 = .0022ufd 472 = .0047ufd

Appendix B

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Soldering Hints

Anyone working in electronics should learn how to solder well. Thankfully it isn't hard, it just takes practice and having the proper tools. Once you are able to solder well, your projects will be more professional and more reliable.

Refer to our video "How To Solder" for detailed explanations.
http://www.youtube.com/watch?v=clDydYlVTqU&feature=channel_page

But before you get started, here are a few safety tips that should be followed:

- Fumes from soldering can be harmful therefore it is important to always have adequate ventilation.
- Wear appropriate clothing when working around hot, molten solder. Never wear shorts or open toes shoes.
- protect hands and equipment from burns by using a soldering iron holder. An improperly stored soldering iron is a fire hazard
- Do not eat, drink, or smoke while you are soldering. Limit exposure to lead.
- Wash hands often when soldering.
- Wear safety glasses when soldering.

Purpose of Soldering

Soldering is used to bond two or more metals together. By applying heat to a connection and feeding solder into this connection, the solder will melt and flow around the metals. A small surface amount of each of the metals will additionally melt and inter-mix with the liquid solder forming an alloy. This connection is called an intermetallic bond and the two metals, when properly soldered together, act as if it they were one solid piece.

Importance of Proper Soldering

Proper soldering is the basis for faithful equipment operation. A good solder connection is physically strong and electrically reliable. A poorly soldered connection will have intermittent operation which can cause electrical damage to neighboring components. At the very least, a bad solder connection will create an unpleasant audible experience. Therefore the importance of good soldering skills cannot be over emphasized. Your sound will rely on it.

Basic Soldering Rules

The following are some basic soldering rules that if followed, will result in a reliably soldered connection every time:

1. Make sure the surfaces to be soldered are clean and free of corrosion. A dirty, greasy, or oxidized surface will not accept solder properly, creating an intermittent solder connection.
2. Establish a firm mechanical connection of the components prior to soldering. Solder should only be used to develop an electrical connection and not a mechanical one.
3. Insure that the soldering tip is clean prior to any soldering. A clean solder tip is one wiped lightly across a damp sponge to remove oxides prior to use. It is essential for maximum heat transfer that there are few contaminants on the tip.

4. When applying the soldering iron to a connection to be made, it is important to lay the tip in such a position that the maximum surface area of the tip is presented to the connection. In this way, the maximum heat is transferred to the connection in the minimal amount of time.
5. Apply solder to the work and not the iron. In this way, a properly heated connection will readily accept the solder, further reducing the chances for unreliability.
6. Use only clean, good quality, rosin core solder. Poor quality or dirty solder will not melt smoothly and will deposit contaminants into the connection, making it weak.
7. Use only the amount of solder needed to complete the connection. Use too little solder and the connections is compromised where as too much solder runs the risk of accidentally contacting neighboring connections.
8. Finish the connection by removing the soldering iron quickly. It is important to apply heat only for as long as it needed to properly flow the solder. Any additional heat runs the risk of overheating the parts being soldered.
9. Do not move the parts of the connection while the solder is hardening. It is important that everything stays totally still until the solder has fully set because any movement in the parts while the solder is in a plastic state will result in a weak, unreliable, and cracked connection.
10. Clean any rosin residues from freshly made connections. Rosin residues can trap dirt and dust that could weaken a connection and possibly create arcing conditions. Isopropyl or ethel alcohol and a stiff bristled brush are good for this.

Sequence of Events to Make a Good Connection

1. Establish a good mechanical connection of the components prior to soldering.
2. Place the tip of the iron firmly against the connection to be soldered.
3. Let connection reach soldering temperature (usually within 1 to 2 seconds).
4. Feed solder into the point where the soldering iron tip meets the connection, not on to the tip of the soldering iron.
5. Feed an adequate amount of solder into the connection for the solder to flow around the components to be joined.
6. When adequate amount has been reached, remove solder and iron simultaneously.
7. Do not move connection or components until solder has solidified.
8. Clip off any excess wire lead(s).

C Appendix C

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Amplifier Care, Feeding, and Applications

Now that your amp is finished, here are a few hints to keep it up and running and you safe and happy:

- Only plug this amp into properly grounded (three prong) AC receptacles.
- Do not cut off the third prong of the power cord plug thus defeating this safety feature.

WARNING *Keith Relf of "The Yardbirds", Leslie Harvey of "Stone the Crows", and John Rostill of "The Shadows" all died of electrocution while playing their guitars (Leslie Harvey while on stage). Proper grounding is more than just important … it can be life or death!*

- Only plug this amp into the properly wired AC voltages.
- Do not expose this amp to high levels of moisture such as rain or spilled liquids.
- Avoid placing any beverages on the cabinet.
- When ever changing tubes or cleaning this amp, disconnect the amp from the AC power source and allow amp to cool for 10 min. before beginning.
- It is recommended that the amp is only plugged to AC power when the amp is being used. Otherwise, it should be left unplugged from AC voltages.
- Avoid exposing this amp to elevated temperatures such as heaters or hot cars or garages. The expansion and contractions of these temperatures will put undo stress on all the solder connections, eventually damaging them.
- Always provide adequate ventilation for the tubes and amplifier. An air space of 6" or more is recommended between the amp and any other object(s), especially around the rear of the amp. It is a good idea to keep the amp as cool as possible.

Amplifier Feeding

As with any tube amp, the choice of tubes will affect the overall tone of the amp. And of course, some tube choices are more dramatic than others. Therefore, I encourage everyone to shape the tone of this amp to suit their tastes through the use of different tubes. Below is a short list of tubes that can be used for adjusting tone performance without modifying the amp.

Preamp tubes:

- 12AX7A / ECC83 / ECC803 / 7025; (high gain / amplification factor = 100)
- 12AD7; (high gain / amplification factor = 100)
- 12AT7 / ECC81; (high gain / amplification factor = 70)
- 12AY7; (med gain / amplification factor = 40)
- 12AU7 / 5814 / 6189 / 5963 / ECC82; (low gain / amplification factor = 17)
- 12AZ7; (med gain / amplification factor = 60)
- 12DW7; (mixed gain / amplification factor, first triode = 100; second triode = 17)
- 5751; (high gain / amplification factor = 70)

Power tubes:

- 6V6GT - 5871 - 7408 - 7184

Rectifier tubes:

- 5Y3GT - 5AX4 - 5CG4 - 5R4 - 5T4
- 5V4 - 5Z4 - 5AR4 - GZ30 - 6106

Applications

The laboratory environment is nice, but field experiences better determine success. Therefore the true test of a good amp is how well it performs “in the field”. The following are some of my favorite field proven gigging and recording hints.

- Run this amp wide open! Let it breath, let it sing. It wants to be heard.
- Insert the guitar or harp mic into the BRIGHT #1 jack. With a short (6”) 1/4” to 1/4” patch cable; insert one plug of this cable into the BRIGHT #2 jack. Then insert the remaining plug into the NORMAL #1 jack. This “channel jumping” arrangement is amazing. Start by turning up the NORMAL channel volume control until a desired tone / response is met. Then bring up the BRIGHT channel volume control to add more sizzle into the sound. Oh my gosh! This ol' Marshall JTM45 trick works here too.
- With the amp wide open, control the level of distortion with the guitar's volume control.
- Try recording this amp by putting a microphone in front, slightly off axis of the speaker to get a crunchy, bluesy tone. Relocate the microphone to directly in front to get an upfront rock tone.
- Instead of one microphone, try recording with two microphones, one in front (straight phase) and another in back (reverse this microphone's phase at the preamp). This will make the amp sound huge when recorded!
- Run the amp into different cabinets (2x12, 4x12, 4x10). It is surprising how different speaker set ups will respond to 18W. Just set microphones to taste and enjoy.
- Record the amp in the bathroom close to the tub. Tubs ring wonderfully when excited.
- A little slap back echo goes along way so try a delay pedal between the guitar and amp.
- A vibrato or tremolo pedal in front is perfect for soulful coolness.
- Run an overdrive pedal set clean in front of the amp. Now crank up the pedal's output and hit the amp hard with this signal. I love this arrangement!
- Harp players can get control of feedback (as well as tone shaping) by putting an EQ pedal between the harp microphone and the amp input. Cut out the offending freq.
- Guitar players can benefit from an EQ pedal in front as well. Just a little more shaping can make everyone happy.
- The low end response can be maximized by situating the amp's cabinet as firmly against the floor as possible. Or, the low end response can be reduced by picking it up off the floor onto a chair.
- Run your guitar / harp microphone into the #1 input and then come out of the #2 input of this amp and go into the front end of a different amp. This way you can run two amps at the same time. The sound of this amp mixed with another is very good.
- Connect the output of this amp to a speaker load box with a line out and this amp becomes a great preamp in which to drive another amp or straight to the board.
- Run a vocal microphone (through the appropriate impedance matching devices) and record the most deliciously distorted vocals ever. No modeling can touch this sound.
- Install a solid state rectifier and get an extra couple of watts of power and an animated dynamics in tone. Use the durable JJ 6V6 power tubes for reliable operation.
- Replace the 6V6's with 5881's or 6L6's for a more expansive sound scape and a to-die-for low end punch. It is best to only run the 5881's and 6L6's when using the solid state rectifier in place of of the tube rectifier. This extra power transformer headroom is needed for the 6L6's and their higher filament requirements.

Appendix D

Templates

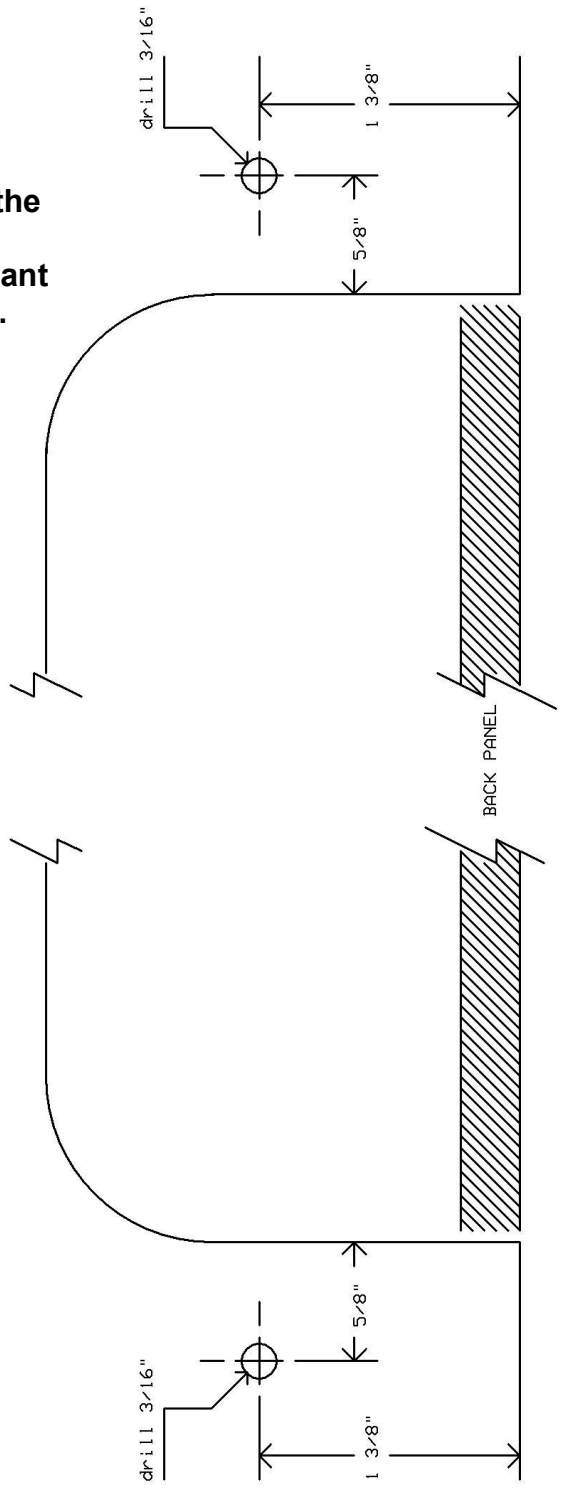
Appendix D1 is the cabinet drilling template …..... pg 43
Appendix D2 is the chassis drilling template – PCB and Turret Boards …..... pg 44

APPENDIX D-1

Make sure the printer is set to print 100% original size to insure a correctly sized template. Adjust size as needed to get correct ratios.

The templates included in the manual may be incorrectly sized therefore, it is important to measure prior to cutting.

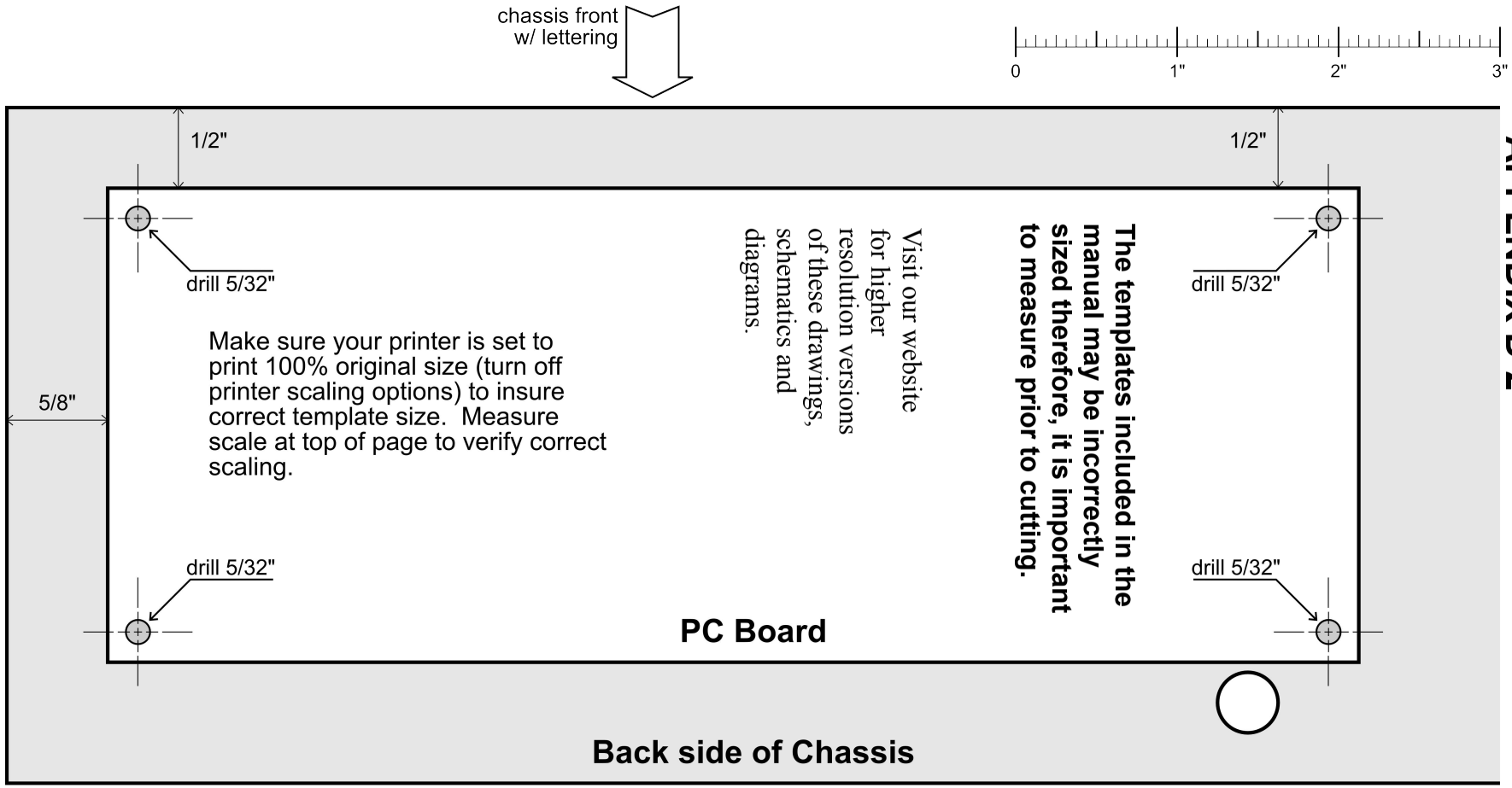
Visit our website for higher resolution versions of these drawings, schematics and diagrams.



Fold along this line

Fold along this line

TubeDepot.com	Tweed 5E3+ - Cabinet Drilling Template	Rev 1.0 5/22/2009	Page 1 of 1
		Robert Hull	


chassis front
w/ lettering
0
1"
2"
3"
1/2"
1/2"
drill 5/32"
drill 5/32"
5/8"
Make sure your printer is set to print 100% original size (turn off printer scaling options) to insure correct template size. Measure scale at top of page to verify correct scaling.
Visit our website for higher resolution versions of these drawings, schematics and diagrams.
The templates included in the manual may be incorrectly sized therefore, it is important to measure prior to cutting.
drill 5/32"
drill 5/32"
PC Board
Back side of Chassis

Recommended method of marking drilling locations:
1 - lay empty PC board on back of metal chasis as shown above.
2 - measure 1/2" and 5/8" spacings as shown above and align PC board to measurements.
3 - use a permanent marker through all four mounting holes of the PC board to indicate drilling locations.
4 - remove empty PC board and use a center punch to firmly mark drilling locations.
5 - with 5/32" drill bit, create holes in chassis.
6 - with holes drilled, clear burrs from both sides of holes.

Alternate method:
1 - lay this template onto the back of the metal chassis.
2 - use a center punch to firmly mark drilling locations through template.
3 - remove template and with 5/32" drill bit, create holes in chassis.
4 - with holes drilled, clear burrs from both sides of holes.

TubeDepot.com		
Tweed 5E3+ - chassis template		
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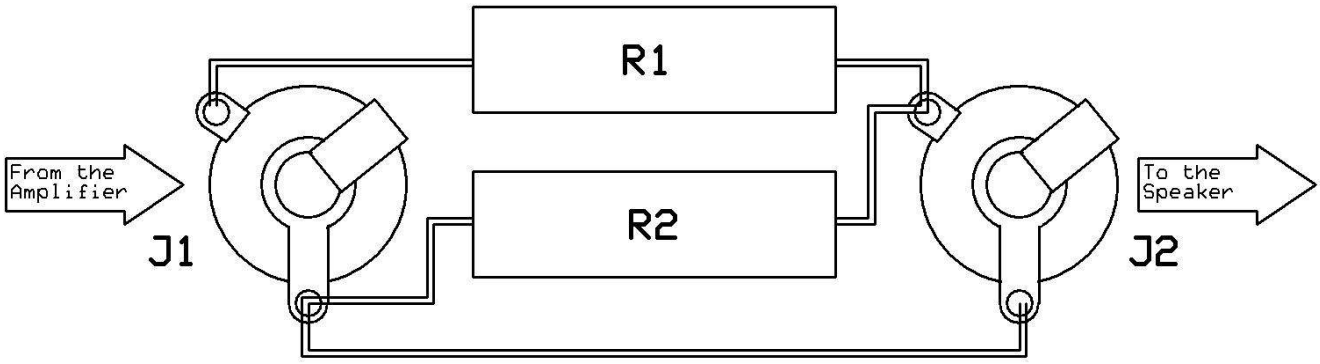
Test Equipment

Load Box

The following load box can be used between an amplifier and a speaker to reduce the volume of the amp and still get distortion. The values are set for a speaker impedance of 8 ohms and an amplifier wattage of no more than 20W.

I've listed several different resistor value sets to choose from based on how much signal power you want making its way to the speaker.

I recommend building everything inside a small metal box. it is important to mount the resistors firmly against the sides of the box. When the load box is in operation, the resistors will get very hot and the heat will be properly dissipated when in contact with the metal sides. To improve this heat transfer, the resistors can be epoxied to the sides of the box.



Power to Speaker (15W source)	Approximate Attenuation	R1 value	R1 wattage	R2 value	R2 wattage
10 watts	- 2db	1.5 ohms	5W	36 ohms	5W
7.3 watts	- 3db	2.4 ohms	10W	18 ohms	10W
5.2 watts	- 5db	3.3 ohms	15W	12 ohms	10W
3.8 watts	- 6db	4.0 ohms	15W	8 ohms	10W
1.9 watts	- 9db	5.1 ohms	25W	4.7 ohms	10W
0.9 watts	- 12db	6.2 ohms	25W	3.9 ohms	5W

These resistors can be wire wound ceramic cast and / or chassis mount and can be sourced from various electronic suppliers such as:

Mouser.com; Jameco.com; Digikey.com

Appendix F

Output Transformer Wiring Options

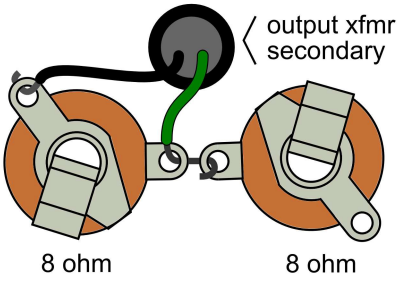
There are different Tweed 5E3+ style output transformers we source for this kit, all of which have slightly different secondary options. From the drawings below, select the drawing that corresponds to the output transformer that came with your kit. Wire your amp accordingly.

MOJO p/n 773 and Classic Tone p/n 40-18002 - single 8 ohm tap (black and green)

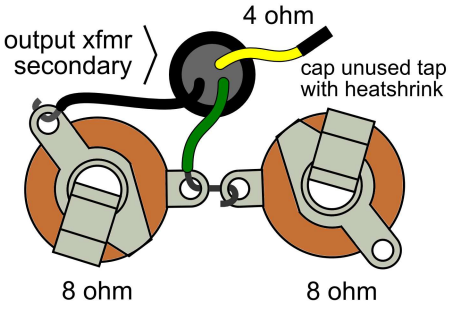
Classic Tone p/n 40-18038 - 4 / 8 ohm tap (black, yellow, and green)

Classic Tone p/n 40-18087 - 4 / 8 / 16 ohm tap (black, yellow, green and brown)

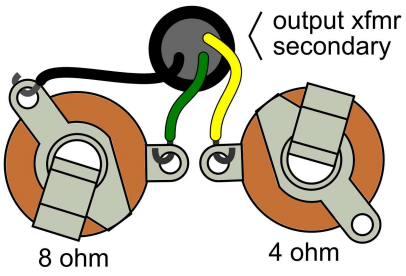
MOJO 773
Classic Tone 40-18002



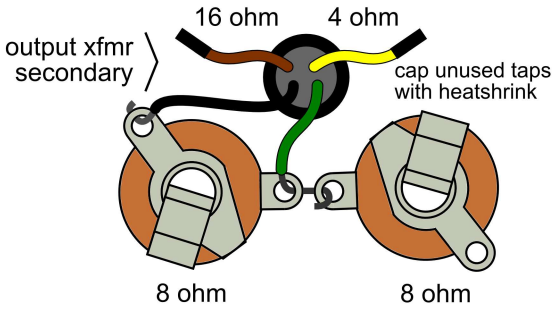
Classic Tone 40-18038



Classic Tone 40-18038
(alternate wiring)



Classic Tone 40-18087



Classic Tone 40-18087
(alternate wiring)